PLATING APPARATUS

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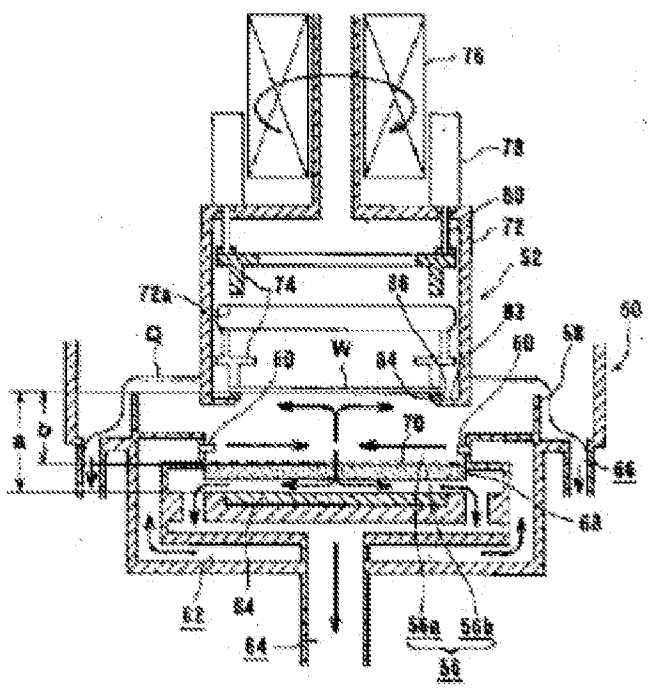
Abstract of **JP2003183892**

PROBLEM TO BE SOLVED: To prevent the variation in within-plane uniformity of a plating film which is formed, by using a soluble anode as the anode, on the plane (surface) to be plated of a substrate accompanying the dissolution of the anode caused by the progress of plating.

SOLUTION: This apparatus has a plating vessel 50 for holding a plating liquid Q; a substrate holder 52 arranged above the plating vessel 50 for freely detachably holding a substrate W with its plane to be plated kept downward; a plating liquid jet nozzle 60 for horizontally jetting the plating liquid from the periphery of the plating vessel 50 toward the center; a soluble anode 54 arranged and dipped in the plating liquid Q in the plating vessel 50; and a straightening plate 68 which is arranged above the anode 54 and below a plane formed by the plating liquid jet nozzle 60 and straightens the flow of the plating liquid Q.



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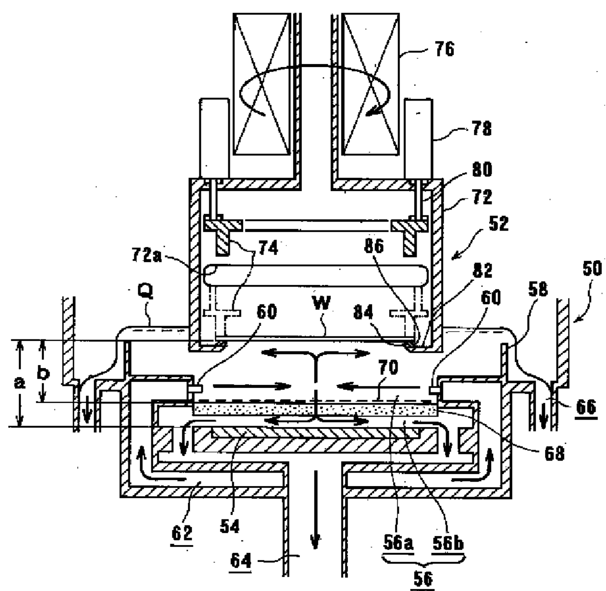
(54)【発明の名称】　めっき装置

(57)【要約】

【課題】　アノードとして溶解性アノードを使用し、しかもめっきの進行によるアノードの溶解に伴って、基板の被めっき面（表面）に形成されるめっき膜の面内均一性が変動してしまうことがないようにする。

【解決手段】　めっき液Ｑを保持するめっき槽５０と、めっき槽５０の上方に配置され、被めっき面を下向きにして基板Ｗを着脱自在に保持する基板ホルダ５２と、めっき槽５０の外周から中央に向けてめっき液を水平に噴射するめっき液噴射ノズル６０と、めっき槽５０内にめっき液Ｑに浸漬させて配置した溶解性のアノード５４と、このアノード５４の上方でめっき液噴射ノズル６０がなす平面の下方に配置され、めっき液Ｑの流れを整流する整流板６８を有する。



【特許請求の範囲】

【請求項１】　めっき液を保持するめっき槽と、
前記めっき槽の上方に配置され、被めっき面を下向きにして基板を着脱自在に保持する基板ホルダと、
前記めっき槽の外周から中央に向けてめっき液を水平に噴射するめっき液噴射ノズルと、
前記めっき槽内にめっき液に浸漬させて配置した溶解性のアノードと、
前記アノードの上方で前記めっき液噴射ノズルがなす平面の下方に配置され、めっき液の流れを整流する整流板を有することを特徴とするめっき装置。

【請求項２】　前記整流板は、平板状で、前記アノードと平行に該アノードの全面を覆うように配置されていることを特徴とする請求項１記載のめっき装置。

【請求項３】　前記整流板は、ポリプロピレン、ポリエチレンまたはＰＴＦＥの多孔性膜または多孔性板、またはセラミックの多孔性板で構成されていることを特徴とする請求項１または２記載のめっき装置。

【請求項４】　前記整流板の密度は、めっき槽内に導入されるめっき液の流量に応じて、めっき液が自重によって整流板の内部を下方に向けて通過し、その逆流を防止する大きさに設定されていることを特徴とする請求項１乃至３のいずれかに記載のめっき装置。

【請求項５】　前記整流板の密度は、１～５Ｌ／ｍｉｎの流量のめっき液が整流板の内部を通過する大きさに設定されていることを特徴とする請求項４記載のめっき装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、半導体ウエハ等の基板の表面（被めっき面）に銅めっき等の金属めっきを施すめっき装置に関する。

【０００２】

【従来の技術】近年、半導体基板上に配線回路を形成するための金属材料として、アルミニウムまたはアルミニウム合金に代えて、電気抵抗率が低くエレクトロマイグレーション耐性が高い銅（Ｃｕ）を用いる動きが顕著になっている。この種の銅配線は、ＣＶＤ、スパッタリング及びめっきといった手法によって、基板のほぼ全表面に銅を成膜して基板の表面に設けた微細凹みの内部に銅を埋込み、余剰な銅を化学機械的研磨（ＣＭＰ）により除去する、いわゆる、ダマシンプロセスによって一般に形成される。

【０００３】図２４（ａ）～（ｃ）は、この種の銅配線基板Wの製造例を工程順に示すもので、図２４（ａ）に示すように、半導体素子を形成した半導体基材１上の導電層１ａの上に$ＳｉＯ_2$酸化膜や他のLow-k材等からなる絶縁層２を堆積し、この絶縁層２の内部に、例えばリソグラフィ・エッチング技術によりコンタクトホール３と配線用溝４を形成し、その上にＴａＮ等からなるバリア層５、更にその上に電解めっきの給電層としてシード層７を形成する。バリア層５としては、Ｔａ／ＴａＮ混合層，ＴｉＮ，WN，ＳｉＴｉN，ＣｏWP，ＣｏWBなども考えられる。

【０００４】そして、図２４（ｂ）に示すように、基板Wの表面に銅めっきを施すことで、基板Wのコンタクトホール３及び配線用溝４内に銅を充填するとともに、絶縁層２上に銅膜６を堆積する。その後、化学機械的研磨（ＣＭＰ）により、絶縁層２上の銅膜６を除去して、コンタクトホール３及び配線用溝４に充填させた銅膜６の表面と絶縁層２の表面とをほぼ同一平面にする。これにより、図２４（ｃ）に示すように、銅膜６からなる配線を形成する。

【０００５】ここで、例えば、めっき浴として硫酸銅浴を使用した電気銅めっきによって基板の表面に銅層を形成するにあたっては、アノードとして、銅にリンを含有させた含リン銅等の溶解性のものが一般に使用されている。これは、アノードとして、不溶解性のものを使用すると、銅イオンの補給が新たに必要となり、この補給の自動化が困難であるばかりでなく、めっき液中の添加剤が酸化分解して異常に消耗したり、発生する酸素により基板の表面や該表面に形成した微細な配線用溝やコンタクトホールの内部に埋込んだ銅層の内部にめっき欠陥が発生したりするという問題があるからである。

【０００６】

【発明が解決しようとする課題】しかし、アノードとして、含リン銅等の溶解性アノードを使用して電気めっきを行うと、めっきの進行に伴ってアノードが溶解することで極間距離（アノードとカソードとなる基板の被めっき面との距離）が変動し、基板の表面に形成されるめっき膜の膜厚の面内均一性が経時的に変わってしまう。更に、アノードの表面に生成されるブラックフィルムが脱落してめっき液中を浮遊し、基板の表面にパーティクルとして付着するといった問題もある。また、半導体ウエハのサイズが大きくなり、直径が３００mmにもなると、極間のめっき液の流れを考えた場合に、極間距離を小さくすることも困難となる。

【０００７】本発明は上記に鑑みて為されたもので、アノードとして溶解性アノードを使用し、しかもめっきの進行によるアノードの溶解に伴って、基板の被めっき面（表面）に形成されるめっき膜の面内均一性が経時的に変動してしまうことがないようにしためっき装置を提供することを目的とする。

【０００８】

【課題を解決するための手段】請求項１に記載の発明は、めっき液を保持するめっき槽と、前記めっき槽の上方に配置され、被めっき面を下向きにして基板を着脱自在に保持する基板ホルダと、前記めっき槽の外周から中央に向けてめっき液を水平に噴射するめっき液噴射ノズルと、前記めっき槽内にめっき液に浸漬させて配置した

溶解性のアノードと、前記アノードの上方でめっき液噴射ノズルがなす平面の下方に配置され、めっき液の流れを整流する整流板を有することを特徴とするめっき装置である。

【０００９】これにより、めっきの進行によるアノードの溶解に伴って、実際の極間距離（アノードとカソードとなる被めっき面との距離）が徐々に変化（大きくなる）しても、基板とアノードとの間に位置する整流板の表面が仮の陽極（擬似アノード）として働き、このため、見かけ上の極間距離（整流板とカソードとなる被めっき面との距離）が常に一定となって、めっき膜の面内均一性が経時的に変化することが防止される。

【００１０】これは、例えばフィルタ材などに使用されるポリプロピレン膜やイオン交換に使用される多孔性イオン交換膜をめっき槽内の陰極（カソード）と陽極（アノード）との間に配置すると、その膜の表面があたかもアノードであるかの如く電場が形成されることを見いだしたことに基づく。図１は、その時に使用しためっき装置を、図２及び図３は、この図１に示すめっき装置を使用して基板（半導体ウエハ）の表面に銅めっきを行って形成した銅めっき膜の膜厚分布を測定した結果をそれぞれ示す。

【００１１】すなわち、図１に示すように、このめっき装置は、基板Wを竪において、基板の表面（被めっき面）にめっきを行うようにしたものであり、めっき槽１０と側板１２を具備し、めっき槽１０には、めっき液を収容するめっき室１４が形成されている。側板１２の下端は、めっき槽１０の下部にヒンジ機構（図示せず）を介して連結されて、めっき槽１０のめっき室１４の開口を開閉できるようになっている。めっき槽１０の側板１２と反対側の面には不溶解性のアノード１６が設けられ、側板１２のめっき槽１０側の面には半導体ウエハ等のめっきを施す基板Wが装着されるようになっている。

【００１２】めっき槽１０のめっき室１４の内部には、側板１２を閉じた状態で、基板Wとアノード１６との間に位置するように、即ち、めっき室１４を基板側領域１４ａとアノード側領域１４ｂに区分（隔離）するように、カチオン交換膜１８が設けられている。めっき槽１０の上下には、上部ヘッダ２０と下部ヘッダ２２が設けられており、上部ヘッダ２０の空隙２０ａと下部ヘッダ２２の空隙２２ａは、基板側領域１４ａに連通している。更に、めっき槽１０には、アノード側領域１４ｂの下部と上部にそれぞれ連通するめっき液入口２４とめっき液出口２６が設けられている。

【００１３】そして、第１めっき液タンク３０から延び、内部に第１ポンプ３２を介装した第１めっき液導入管３４がめっき液入口２４に接続され、第１めっき液タンク３０から延びる第１めっき液排出管３６がめっき液出口２６に接続されている。一方、第２めっき液タンク３８から延び、内部に第２ポンプ４０を介装した第２めっき液導入管４２が下部ヘッダ２２に接続され、第２めっき液タンク３８から延びる第２めっき液排出管４４が上部ヘッダ２０に接続されている。これによって、第１ポンプ３２の駆動に伴って、第１めっき液タンク３０内のめっき液がめっき室１４のアノード側領域１４ｂ内に導入されて循環し、第２ポンプ４０の駆動に伴って、第２めっき液タンク３８内のめっき液がめっき室１４の基板側領域１４ａに導入されて循環するようになっている。

【００１４】上記のようなめっき装置において、表面にシード層７（図２４（ａ）参照）を形成した直径２００ｍｍの基板（半導体ウエハ）Ｗを側板１２に装着し、この基板Ｗのシード層７とアノード１６との間にめっき電圧を印加しつつ、めっき室１４の内部にめっき液を導入してめっきを行った。この時、めっき室１４のカチオン交換膜１８で区画されたアノード側領域１４ｂ内のめっき液圧力の方が、基板側領域１４ａ内のめっき液圧力より高くなるように、第１ポンプ３２のポンプ圧力P_1を第２ポンプ４０のポンプ圧力P_2よりも高く（$P_1 > P_2$）設定した。このようにして形成しためっき膜の膜厚分布を測定した結果を図２に示す。この図２から明らかなように、めっき膜の膜厚は、基板Ｗの中央部で厚くなっていることが判る。

【００１５】次に、図１に示す装置において、カチオン交換膜１８を削除した状態でめっきを行い、このめっきによって形成しためっき膜の膜厚分布を測定した。この時の結果を図３に示す。この図３から明らかなように、めっき膜の膜厚は、基板の外周部で厚くなっていることが判る。

【００１６】このように、実際の極間距離（シード層７とアノード１６との距離）が変わっていないにも拘わらず、図２に示すデータが得られたということは、カチオン交換膜１８が該カチオン交換膜１８を挟んだ両側の領域１４ａ，１４ｂの圧力差により基板Ｗの方向に向かって湾曲し、カチオン交換膜１８の中央部分が基板Ｗに接近したためである。図１に示すめっき装置で、逆に第１ポンプ３２のポンプ圧力P_1を第２ポンプ４０のポンプ圧力P_2よりも低く（$P_1 < P_2$）設定すると、基板中央部は薄くなることが確かめられている。

【００１７】このことは、カチオン交換膜の表面の電位がめっき液中の電場の作用で等電位になる傾向を示しており、カチオン交換膜の表面が仮の陽極として働いていることになる。なお、膜は、イオン交換膜でなくとも、中性のフィルタ材でも同様の結果が得られ、また、薄膜でなくとも、非導電性の多孔性板材でも同様な結果が得られている。

【００１８】請求項２に記載の発明は、前記整流板は、平板状で、前記アノードと平行に該アノードの全面を覆うように配置されていることを特徴とする請求項１記載のめっき装置である。これにより、見かけ上の極間の全

面における電流密度を一定にするとともに、めっき槽内に導入されためっき液が整流板に沿ってスムーズに流れるようにすることができる。請求項３に記載の発明は、前記整流板は、ポリプロピレン、ポリエチレンまたはＰＴＦＥの多孔性膜または多孔性板、またはセラミックの多孔性板で構成されていることを特徴とする請求項１または２記載のめっき装置である。

【００１９】請求項４に記載の発明は、前記整流板の密度は、めっき槽内に導入されるめっき液の流量に応じて、めっき液がその自重によって整流板の内部を下方に向けて通過し、その逆流を防止する大きさに設定されていることを特徴とする請求項１乃至３のいずれかに記載のめっき装置である。これにより、アノードの表面に生成されたブラックフィルムが整流板を逆流して基板の表面に到達してしまうことを防止することができる。請求項５に記載の発明は、前記整流板の密度は、１～５Ｌ／ｍｉｎの流量のめっき液が整流板の内部を通過する大きさに設定されていることを特徴とする請求項４記載のめっき装置である。

【００２０】

【発明の実施の形態】以下、本発明の実施の形態を図面を参照して説明する。図４は、本発明の実施の形態のめっき装置を示す。このめっき装置は、略円筒状で内部にめっき液Ｑを収容するめっき槽５０と、このめっき槽５０の上方に配置されて基板Ｗを着脱自在に保持する基板ホルダ５２とから主に構成されている。なお、図１は、基板ホルダ５２で基板Ｗを保持してめっき液Ｑの液面を上昇させためっき位置にある時の状態を示している。

【００２１】めっき槽５０には、上方に開放し、含リン銅等の溶解性アノード５４を底部に配置し、内部にめっき液Ｑを保有するめっき室５６を有している。めっき室５６の内周面を区画形成する周壁５８には、めっき室５６の中心に向かって水平に突出するめっき液噴射ノズル６０が円周方向に沿って等間隔で配置され、このめっき液噴射ノズル６０は、めっき槽５０の外周部に区画形成しためっき液供給路６２に連通している。このめっき液供給路６２は、図示しないめっき液供給管に接続されている。

【００２２】めっき槽５０には、めっき室５６内のめっき液Ｑを該めっき室５６の底部周縁から引抜く第１めっき液排出路６４と、めっき室５６の内周面を区画形成する周壁５８の上端部をオーバフローしためっき液Ｑを排出する第２めっき液排出路６６が設けられている。これらのめっき液排出路６４，６６は、図示しないめっき液排出管に接続されている。

【００２３】めっき槽５０のめっき室５６の内部には、アノード５４の上方で、かつめっき液噴射ノズル６０がなす平面の下方に位置して、整流板６８がアノード５４と平行で、かつアノード５４の全面を覆うように配置されている。これによって、めっき室５６が整流板６８によって基板側領域５６ａとアノード側領域５６ｂに区分（隔離）され、このめっき液噴射ノズル６０によって、この基板側領域５６ａ側からめっき液Ｑが導入されるようになっている。

【００２４】この整流板６８は、例えば、ポリプロピレン、ポリエチレンまたはＰＴＦＥ（ポリテトラフルオロエチレン）の多孔性膜または多孔性板、またはセラミックの多孔性板で構成されている。この整流板６８の密度は、めっき槽５０内に導入されるめっき液Ｑの流量に応じて、めっき液Ｑがその自重によって整流板６８の内部を下方に向けて通過し、その逆流を防止する大きさに設定されている。

【００２５】つまり、めっき液噴射ノズル６０から噴射されてめっき室５６の内部に導入されためっき液Ｑは、めっき室５６の中央部で衝突し、上昇する流れと下降する流れに分かれる。そして、下降した流れは、整流板６８の内部を通過し、アノード５４の表面に沿って流れて、アノード５４の外周部から下方に排出される。この時の流量は、例えば１～５Ｌ／ｍｉｎ程度が望ましく、この流量が、整流板６８の内部を均一に、しかも逆流がなく流れるようにするためには、この流量に見合った流路を確保する必要がある。このため、この例では、整流板６８の上方に位置するめっき液Ｑの液面の高さだけのヘッドによる自然流下で、１～５Ｌ／ｍｉｎのめっき液が整流板６８の内部を通過するように、整流板６８の密度が設定されている。これにより、アノード５４の表面に生成されたブラックフィルムが整流板６８の内部を逆流して、基板Ｗの表面に到達することを防止することができる。

【００２６】この整流板６８は、基板ホルダ５２で保持した基板Ｗの表面（被めっき面）にめっきを行う際に、めっき室５６内に収容しためっき液Ｑ中に浸漬させたアノード５４と、めっき室５６内のめっき液Ｑに接触させる基板の表面（被めっき面）との間に位置し、これによって、前述のように、仮の陽極（擬似アノード）としての役割を果たす。このように、整流板６８に擬似アノードとしての役割を果たさせることで、実際の極間距離、すなわちアノード５４と基板の表面（被めっき面）との距離ａがめっきの進行によるアノード５４の溶解に伴って徐々に大きくなっても、見かけ上の極間距離、すなわち整流板６８の表面と基板の表面（被めっき面）との距離ｂは常に一定となり、これによって、めっきによって形成されるめっき膜の面内均一性が経時的に変化することが防止される。

【００２７】整流板６８は、平板状の形状で、基板Ｗと平行に配置することが好ましい。これにより、見かけ上の極間の全面における電流密度をより一定にするとともに、めっき槽５０のめっき室５６内に導入されためっき液Ｑが整流板６８に沿ってスムーズに流れるようにすることができる。更に、基板の径が大きくなって、めっき

液噴射ノズルから噴射されるめっき液をめっき室の中央部に到達させるため、実際の極間距離を近づけることができなくなっても、整流板を擬似アノードとすることで、見かけの極間距離を小さくすることが可能となる。

【0028】この例では、整流板68の上方位置に、例えば3mm程度の多数の穴を設けたパンチプレート70が配置され、これによって、整流板68の内部をめっき液Qが逆流しても、アノード54の表面に形成されたブラックフィルムが基板Wに付着しないようになっている。パンチプレート70は、整流板68の下方位置に配置しても、整流板に内蔵してもよく、パンチングプレートを設けなくてもよい。

【0029】基板ホルダ52は、下方に開口した有底円筒状で周壁に開口72aを有するハウジング72と、このハウジング72の内部に配置した押圧リング74とを有しており、このハウジング72は、モータ76の出力軸に連結され、押圧リング74は、ハウジング72に下向きに取付けたシリンダ78のシリンダロッド80に連結されている。ハウジング72の下端には、内方に突出するリング状の基板保持部82が設けられ、この基板保持部82に、内方に突出し、上面の先端が上方に尖塔状に突出するリング状のシール材84が取付けられている。更に、このシール材84の外方に複数のカソード電極用接点86が配置されている。

【0030】これによって、めっき液Qの液面を下げた状態で、基板Wを吸着ハンド等で保持してハウジング72の内部に入れて基板保持部82のシール材84の上面に載置し、吸着ハンドをハウジング72から引抜いた後、押圧リング74を下降させる。これにより、基板Wの周縁部をシール材84と押圧リング74の下面で挟持して基板Wを保持し、しかも基板Wを保持した時に基板Wの下面とシール材84が圧接して、ここを確実にシールし、同時に、基板Wの表面（被めっき面）に設けたシード層7（図24（a）a参照）とカソード電極用接点86とが通電して、シード層7がカソードとなるようになっている。

【0031】次に、このめっき装置によるめっき処理について説明する。先ず、搬送ロボットの吸着ハンドと該ハンドで表面を下に向けて吸着保持した基板Wを、ハウジング72の開口72aからこの内部に挿入し、吸着ハンドを下方に移動させた後、真空吸着を解除して、基板Wをハウジング72の基板保持部82上に載置し、しかる後、吸着ハンドを上昇させてハウジング72から引抜く。次に、押圧リング74を下降させて、基板Wの周縁部を基板保持部82と押圧リング74の下面で挟持して基板Wを保持する。

【0032】そして、めっき液噴射ノズル60からめっき液Qを噴射させ、同時にハウジング72とそれに保持された基板Wを中速で回転させ、めっき液Qが所定の量まで充たされ、更に数秒経過した時に、ハウジング72の回転速度を低速回転（例えば、100min^{-1}）に低下させ、アノード54と、カソードとなる基板Wの表面に設けたシード層7（図24（a）参照）との間にめっき電流を流して電気めっきを行う。

【0033】この時、前述のように、整流板68が擬似アノードとしての役割を果たし、この整流板（擬似アノード）68と基板Wの表面に設けたシード層7との間の電流密度によってめっきが支配され、これによって、めっきの進行によってアノード54が溶解しても、見かけ上の極間距離、すなわち整流板68の表面と基板の表面（被めっき面）との距離bは常に一定となって、めっきによって形成されるめっき膜の面内均一性が経時的に変化することはない。

【0034】めっきを終了した後、めっき室56のめっき液Qを抜き、ハウジング72及びそれに保持された基板Wを露出させる。この状態で、ハウジング72とそれに保持された基板Wを高速（例えば、500～800min^{-1}）で回転させてめっき液を遠心力により液切りする。液切りが終了した後、ハウジング72が所定の方向に向くようにしてハウジング72の回転を停止させる。

【0035】ハウジング72が完全に停止した後、押圧リング74を上昇させる。次に、搬送ロボット吸着ハンド等を吸着面を下に向けて、ハウジング72の開口72aからこの内部に挿入し、吸着ハンドが基板を吸着できる位置にまで吸着ハンドを下降させる。そして、基板を吸着ハンドにより真空吸着し、吸着ハンドをハウジング72の開口72aの上部まで移動させて、ハウジング72の開口72aから吸着ハンドとそれに保持した基板を取り出す。

【0036】図5は、前述のめっき装置を備えた基板処理装置の平面配置図を示す。図示するように、この基板処理装置は、半導体基板を収容した基板カセットの受け渡しを行う搬入・搬出エリア520と、プロセス処理を行うプロセスエリア530と、プロセス処理後の半導体基板の洗浄及び乾燥を行う洗浄・乾燥エリア540を具備する。洗浄・乾燥エリア540は、搬入・搬出エリア520とプロセスエリア530の間に配置されている。搬入・搬出エリア520と洗浄・乾燥エリア540には隔壁521を設け、洗浄・乾燥エリア540とプロセスエリア530の間には隔壁523を設けている。

【0037】隔壁521には、搬入・搬出エリア520と洗浄・乾燥エリア540との間で半導体基板を受け渡すための通路（図示せず）を設け、該通路を開閉するためのシャッター522を設けている。また、隔壁523にも洗浄・乾燥エリア540とプロセスエリア530との間で半導体基板を受け渡すための通路（図示せず）を設け、該通路を開閉するためのシャッター524を設けている。洗浄・乾燥エリア540とプロセスエリア530は独自に給排気できるようになっている。

【0038】上記構成の半導体基板配線用の基板処理装置はクリーンルーム内に設置され、各エリアの圧力は、（搬入・搬出エリア520の圧力）＞（洗浄・乾燥エリア540の圧力）＞（プロセスエリア530の圧力）に設定され、且つ搬入・搬出エリア520の圧力は、クリーンルーム内圧力より低く設定される。これにより、プロセスエリア530から洗浄・乾燥エリア540に空気が流出しないようにし、洗浄・乾燥エリア540から搬入・搬出エリア520に空気が流出しないようにし、さらに搬入・搬出エリア520からクリーンルーム内に空気が流出しないようにしている。

【0039】搬入・搬出エリア520には、半導体基板を収容した基板カセットを収納するロードユニット520aとアンロードユニット520bが配置されている。洗浄・乾燥エリア540には、めっき処理後の処理を行う各2基の水洗部541、乾燥部542が配置されると共に、半導体基板の搬送を行う搬送部（搬送ロボット）543が備えられている。ここに水洗部541としては、例えば前端にスポンジがついたペンシル型のものやスポンジ付きローラ形式のものが用いられる。乾燥部542としては、例えば半導体基板を高速でスピンさせて脱水、乾燥させる形式のものが用いられる。プロセスエリア530内には、半導体基板のめっきの前処理を行う前処理槽531と、銅めっき処理を行うめっき槽（めっき装置）532が配置されると共に、半導体基板の搬送を行う搬送部（搬送ロボット）533が備えられている。

【0040】図6は、基板処理装置内の気流の流れを示す。洗浄・乾燥エリア540においては、配管546より新鮮な外部空気が取込まれ、高性能フィルタ544を通してファンにより押込まれ、天井540aよりダウンフローのクリーンエアとして水洗部541、乾燥部542の周囲に供給される。供給されたクリーンエアの大部分は、床540bより循環配管545により天井540a側に戻され、再び高性能フィルタ544を通してファンにより押込まれて、洗浄・乾燥エリア540内に循環する。一部の気流は、水洗部541及び乾燥部542内からダクト552を通って排気される。

【0041】プロセスエリア530は、ウエットゾーンといいながらも、半導体基板表面にパーティクルが付着することは許されない。このためプロセスエリア530内に天井530aより、ファンにより押込まれて高性能フィルタ533を通してダウンフローのクリーンエアを流すことにより、半導体基板にパーティクルが付着することを防止している。しかしながら、ダウンフローを形成するクリーンエアの全流量を外部からの給排気に依存すると、膨大な給排気量が必要となる。このため、室内を負圧に保つ程度の排気のみをダクト553よりの外部排気とし、ダウンフローの大部分の気流を、配管534，535を通した循環気流でまかなうようにしている。

【0042】循環気流とした場合に、プロセスエリア530を通過したクリーンエアは、薬液ミストや気体を含むため、これをスクラバ536及びミトセパレータ537，538を通して除去する。これにより天井530a側の循環ダクト534に戻ったエアは、薬液ミストや気体を含まないものとなり、再びファンにより押込まれて高性能フィルタ533を通ってプロセスエリア530内にクリーンエアとして循環する。床部530bよりプロセスエリア530内を通ったエアの一部は、ダクト553を通って外部に排出され、薬液ミストや気体を含むエアがダクト553を通って外部に排出される。天井530aのダクト539からは、これらの排気量に見合った新鮮な空気がプロセスエリア530内に負圧に保った程度に供給される。

【0043】上記のように搬入・搬出エリア520、洗浄・乾燥エリア540及びプロセスエリア530のそれぞれの圧力は、

（搬入・搬出エリア520の圧力）＞（洗浄・乾燥エリア540の圧力）＞（プロセスエリア530の圧力）

に設定されている。従って、シャッター522，524（図5参照）を開放すると、これらのエリア間の空気の流れは、図6に示すように、搬入・搬出エリア520、洗浄・乾燥エリア540及びプロセスエリア530の順に流れる。また、排気はダクト552及び553を通して、図8に示すように、集合排気ダクト554に集められる。

【0044】図7は、基板処理装置がクリーンルーム内に配置された一例を示す外観図である。搬入・搬出エリア520のカセット受渡し口555と操作パネル556のある側面が仕切壁557で仕切られたクリーンルームのクリーン度の高いワーキングゾーン558に露出しており、その他の側面は、クリーン度の低いユーティリティゾーン559に収納されている。

【0045】上記のように、洗浄・乾燥エリア540を搬入・搬出エリア520とプロセスエリア530の間に配置し、搬入・搬出エリア520と洗浄・乾燥エリア540の間及び洗浄・乾燥エリア540とプロセスエリア530の間にはそれぞれ隔壁521を設けたので、ワーキングゾーン558から乾燥した状態でカセット受渡し口555を通して半導体基板配線用の基板処理装置内に搬入される半導体基板は、基板処理装置内でめっき処理され、洗浄・乾燥した状態でワーキングゾーン558に搬出されるので、半導体基板面にはパーティクルやミストが付着することなく、且つクリーンルーム内のクリーン度の高いワーキングゾーン558をパーティクルや薬液や洗浄液ミストで汚染することはない。

【0046】なお、図5及び図6では、基板処理装置が搬入・搬出エリア520、洗浄・乾燥エリア540、プロセスエリア530を具備する例を示したが、プロセス

エリア５３０内又はプロセスエリア５３０に隣接してＣＭＰ装置を配置するエリアを設け、該プロセスエリア５３０又はＣＭＰ装置を配置するエリアと搬入・搬出エリア５２０の間に洗浄・乾燥エリア５４０を配置するように構成しても良い。要は半導体基板配線用の基板処理装置に半導体基板が乾燥状態で搬入され、めっき処理の終了した半導体基板が洗浄され、乾燥した状態で排出される構成であればよい。

【００４７】上記例では、基板処理装置を半導体基板配線用のめっき装置を例に説明したが、基板は半導体基板に限定されるものではなく、またかっき処理する部分も基板面上に形成された配線部に限定されるものではない。また、上記例では銅めっきを例に説明したが、銅めっきに限定されるものではない。

【００４８】図9は、半導体基板配線用の他の基板処理装置の平面構成を示す図である。図示するように、半導体基板配線用の基板処理装置は、半導体基板を搬入する搬入部６０１、銅めっきを行う銅めっき槽６０２、水洗浄を行う水洗槽６０３，６０４、化学機械研磨（ＣＭＰ）を行うＣＭＰ部６０５、水洗槽６０６，６０７、乾燥槽６０８及び配線層形成が終了した半導体基板を搬出する搬出部６０９を具備し、これら各槽に半導体基板を移送する図示しない基板移送手段が１つの装置として配置され、半導体基板配線用の基板処理装置を構成している。

【００４９】上記配置構成の基板処理装置において、基板移送手段により、搬入部６０１に載置された基板カセット６０１－１から、配線層が形成されていない半導体基板を取り出し、銅めっき槽６０２に移送する。該銅めっき槽６０２において、配線溝や配線孔（コンタクトホール）からなる配線部を含む半導体基板Ｗの表面上に銅めっき層を形成する。

【００５０】前記銅めっき層６０２で銅めっき層の形成が終了した半導体基板Ｗを、基板移送手段で水洗槽６０３及び水洗槽６０４に移送し、水洗を行う。続いて該水洗浄の終了した半導体基板Ｗを基板移送手段でＣＭＰ部６０５に移送し、該ＣＭＰ部６０５で、銅めっき層から配線溝や配線孔に形成した銅めっき層を残して半導体基板Ｗの表面上の銅めっき層を除去する。

【００５１】続いて上記のように銅めっき層から配線溝や配線孔からなる配線部に形成した銅めっき層を残して半導体基板Ｗの表面上の不要の銅めっき層の除去が終了した半導体基板Ｗを、基板移送手段で水洗槽６０６及び水洗槽６０７に送り、水洗浄し、更に水洗浄の終了した半導体基板Ｗは乾燥槽６０８で乾燥させ、乾燥の終了した半導体基板Ｗを配線層の形成の終了した半導体基板として、搬出部６０９の基板カセット６０９－１に格納する。

【００５２】図１０は、半導体基板配線用の他の基板処理装置の平面構成を示す図である。図１０に示す基板処理装置が図９に示す装置と異なる点は、銅めっき槽６０２、銅めっき膜の表面に保護膜を形成する蓋めっき槽６１２、ＣＭＰ部６１５、水洗槽６１３、６１４を追加し、これらを含め１つの装置として構成した点である。

【００５３】上記配置構成の基板処理装置において、配線溝や配線孔（コンタクトホール）からなる配線部を含む半導体基板Ｗの表面上に銅めっき層を形成する。続いて、ＣＭＰ部６０５で銅めっき層から配線溝や配線孔に形成した銅めっき層を残して半導体基板Ｗの表面上の銅めっき層を除去する。

【００５４】続いて、上記のように銅めっき層から配線溝や配線孔からなる配線部に形成した銅めっき層を残して半導体基板Ｗの表面上の銅めっき層を除去した半導体基板Ｗを水洗槽６１０に移送し、ここで水洗浄する。続いて、前処理槽６１１で、後述する蓋めっきを行うための前処理を行う。該前処理の終了した半導体基板Ｗを蓋めっき槽６１２に移送し、蓋めっき槽６１２で配線部に形成した銅めっき層の上に保護膜を形成する。この保護膜としては、例えばＮｉ－Ｂ無電解めっき槽を用いる。保護膜を形成した後、半導体基板Ｗを水洗槽６０６，６０７で水洗浄し、更に乾燥槽６０８で乾燥させる。そして、銅めっき層上に形成した保護膜の上部をＣＭＰ部６１５で研磨し、平坦化して、水洗槽６１３，６１４で水洗浄した後、乾燥槽６０８で乾燥させ、半導体基板Ｗを搬出部６０９の基板カセット６０９－１に格納する。

【００５５】図１１は半導体基板配線用の他の基板処理装置の平面構造を示す図である。図示するように、この基板処理装置は、ロボット６１６を中央に配置し、その周囲のロボットアーム６１６－１が到達する範囲に銅めっきを行う銅めっき槽６０２、水洗槽６０３、水洗槽６０４、ＣＭＰ部６０５、蓋めっき槽６１２、乾燥槽６０８及びロード・アンロード部６１７を配置して１つの装置として構成したものである。なお、ロード・アンロード部６１７に隣接して半導体基板の搬入部６０１及び搬出部６０９が配置されている。

【００５６】上記構成の半導体基板配線用の基板処理装置において、半導体基板の搬入部６０１から配線めっきの済んでいない半導体基板がロード・アンロード部６１７に移送され、該半導体基板をロボットアーム６１６－１が受け取り、銅めっき槽６０２に移送し、該めっき槽で配線溝や配線孔からなる配線部を含む半導体基板の表面上に銅めっき層を形成する。該銅めっき層の形成された半導体基板をロボットアーム６１６－１によりＣＭＰ部６０５に移送し、該ＣＭＰ部６０５で銅めっき層から配線溝や配線孔からなる配線部に形成した銅めっき層を残して半導体基板Ｗの表面上の余分な銅めっき層を除去する。

【００５７】表面の余分な銅めっき層が除去された半導体基板はロボットアーム６１６－１により、水洗槽６０４に移送され、水洗処理された後、前処理槽６１１に移

送され、該前処理槽６１１でカバーメッキ前の前処理が行われる。該前処理の終了した半導体基板はロボットアーム６１６－１により、カバーメッキ槽６１２に移送され、該カバーメッキ槽６１２で、配線溝や配線孔からなる配線部に形成され銅めっき層の上に保護膜を形成する。保護膜が形成された半導体基板はロボットアーム６１６－１により、水洗槽６０４に移送されここで水洗処理された後、乾燥槽６０８に移送され、乾燥した後、ロード·アンロード部６１７に移送される。該配線めっきの終了した半導体基板は搬出部６０９に移送される。

【００５８】図１２は、他の半導体基板処理装置の平面構成を示す図である。この半導体基板処理装置は、ロード・アンロード部７０１、銅めっきユニット７０２、第１ロボット７０３、第3洗浄機７０４、反転機７０５、反転機７０６、第2洗浄機７０７、第２ロボット７０８、第１洗浄機７０９、第１ポリッシング装置７１０及び第２ポリッシング装置７１１を配置した構成である。第１ロボット７０３の近傍には、めっき前後の膜厚を測定するめっき前後膜厚測定機７１２、研磨後で乾燥状態の半導体基板Wの膜厚を測定する乾燥状態膜厚測定機７１３が配置されている。

【００５９】第１ポリッシング装置（研磨ユニット）７１０は、研磨テーブル７１０－１、トップリング７１０－２、トップリングヘッド７１０－３、膜厚測定機７１０－４、プッシャー７１０－５を具備している。第2ポリッシング装置（研磨ユニット）７１１は、研磨テーブル７１１－１、トップリング７１１－２、トップリングヘッド７１１－３、膜厚測定機７１１－４、プッシャー７１１－５を具備している。

【００６０】コンタクトホールと配線用の溝が形成され、その上にシード層が形成された半導体基板Wを収容したカセット７０１－１をロード・アンロード部７０１のロードポートに載置する。第１ロボット７０３は、半導体基板Wをカセット７０１－１から取り出し、銅めっきユニット７０２に搬入し、銅めっき膜を形成する。その時、めっき前後膜厚測定機７１２でシード層の膜厚を測定する。銅めっき膜の成膜は、まず半導体基板Wの表面の親水処理を行い、その後銅めっきを行って形成する。銅めっき膜の形成後、銅めっきユニット７０２でリンス若しくは洗浄を行う。時間に余裕があれば、乾燥してもよい。

【００６１】第１ロボット７０３で銅めっきユニット７０２から半導体基板Wを取り出したとき、めっき前後膜厚測定機７１２で銅めっき膜の膜厚を測定する。その測定結果は、記録装置（図示せず）に半導体基板の記録データとして記録され、なお且つ、銅めっきユニット７０２の異常の判定にも使用される。膜厚測定後、第１ロボット７０３が反転機７０５に半導体基板Wを渡し、該反転機７０５で反転させる（銅めっき膜が形成された面が下になる）。第１ポリッシング装置７１０、第2ポリッシング装置７１１による研磨には、シリーズモードとパラレルモードがある。以下、シリーズモードの研磨について説明する。

【００６２】シリーズモード研磨は、１次研磨をポリッシング装置７１０で行い、２次研磨をポリッシング装置７１１で行う研磨である。第2ロボット７０８で反転機７０５上の半導体基板Wを取り上げ、ポリッシング装置７１０のプッシャー７１０－５上に半導体基板Wを載せる。トップリング７１０－２はプッシャー７１０－５上の該半導体基板Wを吸着し、研磨テーブル７１０－１の研磨面に半導体基板Wの銅めっき膜形成面を当接押圧し、１次研磨を行う。該１次研磨では基本的に銅めっき膜が研磨される。研磨テーブル７１０－１の研磨面は、ＩＣ１０００のような発泡ポリウレタン、又は砥粒を固定若しくは含浸させたもので構成されている。該研磨面と半導体基板Wの相対運動で銅めっき膜が研磨される。

【００６３】銅めっき膜の研磨終了後、トップリング７１０－２で半導体基板Wをプッシャー７１０－５上に戻す。第2ロボット７０８は、該半導体基板Wを取り上げ、第１洗浄機７０９に入れる。この時、プッシャー７１０－５上にある半導体基板Wの表面及び裏面に薬液を噴射しパーティクルを除去したり、つきにくくしたりすることもある。

【００６４】第１洗浄機７０９において洗浄終了後、第２ロボット７０８で半導体基板Wを取り上げ、第２ポリッシング装置７１１のプッシャー７１１－５上に半導体基板Wを載せる。トップリング７１１－２でプッシャー７１１－５上の半導体基板Wを吸着し、該半導体基板Wのバリア層を形成した面を研磨テーブル７１１－１の研磨面に当接押圧して２次研磨を行う。この２次研磨ではバリア層が研磨される。但し、上記１次研磨で残った銅膜や酸化膜も研磨されるケースもある。

【００６５】研磨テーブル７１１－１の研磨面は、ＩＣ１０００のような発泡ポリウレタン、又は砥粒を固定若しくは含浸させたもので構成され、該研磨面と半導体基板Wの相対運動で研磨される。このとき、砥粒若しくはスラリーには、シリカ、アルミナ、セリア等が用いられる。薬液は、研磨したい膜種により調整される。

【００６６】２次研磨の終点の検知は、光学式の膜厚測定機を用いてバリア層の膜厚を測定し、膜厚が０になったこと又はSiO_2 からなる絶縁膜の表面検知で行う。また、研磨テーブル７１１－１の近傍に設けた膜厚測定機７１１－４として画像処理機能付きの膜厚測定機を用い、酸化膜の測定を行い、半導体基板Wの加工記録として残したり、２次研磨の終了した半導体基板Wを次の工程に移送できるか否かの判定を行う。また、２次研磨終点に達していない場合は、再研磨を行ったり、なんらかの異常で規定値を超えて研磨された場合は、不良品を増やさないように次の研磨を行わないよう半導体基板処理装置を停止させる。

【0067】2次研磨終了後、トップリング711－2で半導体基板Wをプッシャー711－5まで移動させる。プッシャー711－5上の半導体基板Wは第2ロボット708で取り上げる。この時、プッシャー711－5上で薬液を半導体基板Wの表面及び裏面に噴射してパーティクルを除去したり、つきにくくすることがある。

【0068】第2ロボット708は、半導体基板Wを第2洗浄機707に搬入し、洗浄を行う。第2洗浄機707の構成も第1洗浄機709と同じ構成である。半導体基板Wの表面は、主にパーティクル除去のために、純水に界面活性剤、キレート剤、またｐＨ調整剤を加えた洗浄液を用いて、ＰＶＡスポンジロールによりスクラブ洗浄される。半導体基板Wの裏面には、ノズルからＤＨＦ等の強い薬液を噴出し、拡散している銅をエッチングしたり、又は拡散の問題がなければ、表面と同じ薬液を用いてＰＶＡスポンジロールによるスクラブ洗浄をする。

【0069】上記洗浄の終了後、半導体基板Wを第2ロボット708で取り上げ、反転機706に移し、該反転機706で反転させる。該反転させた半導体基板Wを第1ロボット703で取り上げ第3洗浄機704に入れる。第3洗浄機704では、半導体基板Wの表面に超音波振動により励起されたメガソニック水を噴射して洗浄する。そのとき純水に界面活性剤、キレート剤、またｐＨ調整剤を加えた洗浄液を用いて公知のペンシル型スポンジで半導体基板Wの表面を洗浄してもよい。その後、スピン乾燥により、半導体基板Wを乾燥させる。上記のように研磨テーブル711－1の近傍に設けた膜厚測定機711－4で膜厚を測定した場合は、そのままロード・アンロード部701のアンロードポートに載置するカセットに収容する。

【0070】図13は、他の半導体基板処理装置の平面構成を示す図である。この半導体基板処理装置の図12に示す半導体基板処理装置と異なる点は、図12に示す銅めっきユニット702の代わりに蓋めっきユニット750を設けた点である。銅膜を形成した半導体基板Wを収容したカセット701－1は、ロード・アンロード部701に載置される。半導体基板Wは、カセット701－1から取り出され、第1ポリッシング装置710または第2ポリッシング装置711に搬送されて、ここで銅膜の表面が研磨される。この研磨終了後、半導体基板Wは、第1洗浄機709に搬送されて洗浄される。

【0071】第1洗浄機709で洗浄された半導体基板Wは、蓋めっきユニット750に搬送され、ここで銅めっき膜の表面に保護膜が形成され、これによって、銅めっき膜が大気中で酸化することが防止される。蓋めっきを施した半導体基板Wは、第2ロボット708によって蓋めっきユニット750から第2洗浄機707に搬送され、ここで純水または脱イオン水で洗浄される。この洗浄後の半導体基板Wは、ロード・アンロード部701に載置されたカセット701－1に戻される。

【0072】図14は、更に他の半導体基板処理装置の平面構成を示す図である。この半導体基板処理装置の図13に示す半導体基板処理装置と異なる点は、図13に示す第1洗浄機709の代わりにアニールユニット751を設けた点である。前述のようにして、第1ポリッシング装置710または第2ポリッシング装置711で研磨され、第2洗浄機707で洗浄された半導体基板Wは、蓋めっきユニット750に搬送され、ここで銅めっき膜の表面に蓋めっきが施される。この蓋めっきが施された半導体基板Wは、第1ロボット703によって、蓋めっきユニット750から第3洗浄機704に搬送され、ここで洗浄される。

【0073】第1洗浄機709で洗浄された半導体基板Wは、アニールユニット751に搬送され、ここでアニールされる。これによって、銅めっき膜が合金化されて銅めっき膜のエレクトロンマイグレーション耐性が向上する。アニールが施された半導体基板Wは、アニールユニット751から第2洗浄機707に搬送され、ここで純水または脱イオン水で洗浄される。この洗浄後の半導体基板Wは、ロード・アンロード部701に載置されたカセット701－1に戻される。

【0074】図15は、基板処理装置の他の平面配置構成を示す図である。図15において、図12と同一符号を付した部分は、同一又は相当部分を示す。この基板研磨装置は、第1ポリッシング装置710と第2ポリッシング装置711に接近してプッシャーインデクサー725を配置し、第3洗浄機704と銅めっきユニット702の近傍にそれぞれ基板載置台721、722を配置し、第1洗浄機709と第3洗浄機704の近傍にロボット723を配置し、第2洗浄機707と銅めっきユニット702の近傍にロボット724を配置し、更にロード・アンロード部701と第1ロボット703の近傍に乾燥状態膜厚測定機713を配置している。

【0075】上記構成の基板処理装置において、第1ロボット703は、ロード・アンロード部701のロードポートに載置されているカセット701－1から半導体基板Wを取り出し、乾燥状態膜厚測定機713でバリア層及びシード層の膜厚を測定した後、該半導体基板Wを基板載置台721に載せる。なお、乾燥状態膜厚測定機713が、第1ロボット703のハンドに設けられている場合は、そこで膜厚を測定し、基板載置台721に載せる。第2ロボット723で基板載置台721上の半導体基板Wを銅めっきユニット702に移送し、銅めっき膜を成膜する。銅めっき膜の成膜後、めっき前後膜厚測定機712で銅めっき膜の膜厚を測定する。その後、第2ロボット723は、半導体基板Wをプッシャーインデクサー725に移送し搭載する。

【0076】〔シリーズモード〕シリーズモードでは、トップリングヘッド710－2がプッシャーインデクサー725上の半導体基板Wを吸着し、研磨テーブル71

０－１に移送し、研磨テーブル７１０－１上の研磨面に該半導体基板Ｗを押圧して研磨を行う。研磨の終点検知は上記と同様な方法で行い、研磨終了後の半導体基板Ｗはトップリングヘッド７１０－２でプッシャーインデクサー７２５に移送され搭載される。第２ロボット７２３で半導体基板Ｗを取り出し、第１洗浄機７０９に搬入し洗浄し、続いてプッシャーインデクサー７２５に移送し搭載する。

【００７７】トップリングヘッド７１１－２がプッシャーインデクサー７２５上の半導体基板Ｗを吸着し、研磨テーブル７１１－１に移送し、その研磨面に該半導体基板Ｗを押圧して研磨を行う。研磨の終点検知は上記と同様な方法で行い、研磨終了後の半導体基板Ｗは、トップリングヘッド７１１－２でプッシャーインデクサー７２５に移送され搭載される。第３ロボット７２４は、半導体基板Ｗを取り上げ、膜厚測定機７２６で膜厚を測定した後、第２洗浄機７０７に搬入し洗浄する。続いて第３洗浄機７０４に搬入し、ここで洗浄した後にスピンドライで乾燥を行い、その後、第３ロボット７２４で半導体基板Ｗを取り上げ、基板載置台７２２上に載せる。

【００７８】〔パラレルモード〕パラレルモードでは、トップリングヘッド７１０－２又は７１１－２がプッシャーインデクサー７２５上の半導体基板Ｗを吸着し、研磨テーブル７１０－１又は７１１－１に移送し、研磨テーブル７１０－１又は７１１－１上の研磨面に該半導体基板Ｗを押圧してそれぞれ研磨を行う。膜厚を測定した後、第３ロボット７２４で半導体基板Ｗを取り上げ、基板載置台７２２上に載せる。第１ロボット７０３は、基板載置台７２２上の半導体基板Ｗを乾燥状態膜厚測定機７１３に移送し、膜厚を測定した後、ロード・アンロード部７０１のカセット７０１－１に戻す。

【００７９】図１６は、基板処理装置の他の平面配置構成を示す図である。この基板処理装置では、シード層が形成されていない半導体基板Ｗに、シード層及び銅めっき膜を形成し、研磨して回路配線を形成する基板処理装置である。この基板研磨装置は、第１ポリッシング装置７１０と第２ポリッシング装置７１１に接近してプッシャーインデクサー７２５を配置し、第２洗浄機７０７とシード層成膜ユニット７２７の近傍にそれぞれ基板載置台７２１、７２２を配置し、シード層成膜ユニット７２７と銅めっきユニット７０２に接近してロボット７２３を配置し、第１洗浄機７０９と第２洗浄機７０７の近傍にロボット７２４を配置し、更にロード・アンロード部７０１と第１ロボット７０３の近傍に乾燥膜厚測定機７１３を配置している。

【００８０】第１ロボット７０３でロード・アンロード部７０１のロードポートに載置されているカセット７０１－１から、バリア層が形成されている半導体基板Ｗを取り出して基板載置台７２１に載せる。次に第２ロボット７２３は、半導体基板Ｗをシード層成膜ユニット７２７に搬送し、シード層を成膜する。このシード層の成膜は無電解めっきで行う。第２ロボット７２３は、シード層の形成された半導体基板をめっき前後膜厚測定機７１２でシード層の膜厚を測定する。膜厚測定後、銅めっきユニット７０２に搬入し、銅めっき膜を形成する。

【００８１】銅めっき膜を形成後、その膜厚を測定し、プッシャーインデクサー７２５に移送する。トップリング７１０－２又は７１１－２は、プッシャーインデクサー７２５上の半導体基板Ｗを吸着し、研磨テーブル７１０－１又は７１１－１に移送し研磨する。研磨後、トップリング７１０－２又は７１１－２は、半導体基板Ｗを膜厚測定機７１０－４又は７１１－４に移送し、膜厚を測定し、プッシャーインデクサー７２５に移送して載せる。

【００８２】次に、第３ロボット７２４は、プッシャーインデクサー７２５から半導体基板Ｗを取り上げ、第１洗浄機７０９に搬入する。第３ロボット７２４は、第１洗浄機７０９から洗浄された半導体基板Ｗを取り上げ、第２洗浄機７０７に搬入し、洗浄し乾燥した半導体基板を基板載置台７２２上に載置する。次に、第１ロボット７０３は、半導体基板Ｗを取り上げ乾燥状態膜厚測定機７１３で膜厚を測定し、ロード・アンロード部７０１のアンロードポートに載置されているカセット７０１－１に収納する。

【００８３】図１６に示す基板処理装置においても、回路パターンのコンタクトホール又は溝が形成された半導体基板Ｗ上にバリア層、シード層及び銅めっき膜を形成して、研磨して回路配線を形成することができる。バリア層形成前の半導体基板Ｗを収容したカセット７０１－１を、ロード・アンロード部７０１のロードポートに載置する。そして、第１ロボット７０３でロード・アンロード部７０１のロードポートに載置されているカセット７０１－１から、半導体基板Ｗを取り出して基板載置台７２１に載せる。次に、第２ロボット７２３は、半導体基板Ｗをシード層成膜ユニット７２７に搬送し、バリア層とシード層を成膜する。このバリア層とシード層の成膜は、無電解めっきで行う。第２ロボット７２３は、めっき前後膜厚測定機７１２で半導体基板Ｗに形成されたバリア層とシード層の膜厚を測定する。膜厚測定後、銅めっきユニット７０２に搬入し、銅めっき膜を形成する。

【００８４】図１７は、基板処理装置の他の平面配置構成を示す図である。この基板処理装置は、バリア層成膜ユニット８１１、シード層成膜ユニット８１２、めっきユニット８１３、アニールユニット８１４、第１洗浄ユニット８１５、ベベル・裏面洗浄ユニット８１６、蓋めっきユニット８１７、第２洗浄ユニット８１８、第１アライナ兼膜厚測定器８４１、第２アライナ兼膜厚測定器８４２、第１基板反転機８４３、第２基板反転機８４４、基板仮置き台８４５、第３膜厚測定器８４６、ロー

ド・アンロード部８２０、第１ポリッシング装置８２１、第２ポリッシング装置８２２、第１ロボット８３１、第２ロボット８３２、第３ロボット８３３、第４ロボット８３４を配置した構成である。なお、膜厚測定器８４１，８４２，８４６はユニットになっており、他のユニット（めっき、洗浄、アニール等のユニット）の間口寸法と同一サイズにしているため、入れ替え自在である。この例では、バリア層成膜ユニット８１１は、無電解Ｒｕめっき装置、シード層成膜ユニット８１２は、無電解銅めっき装置、めっきユニット８１３は、電解めっき装置を用いることができる。

【００８５】図１８は、この基板処理装置内での各工程の流れを示すフローチャートである。このフローチャートにしたがって、この装置内での各工程について説明する。先ず、第１ロボット８３１によりロード・アンロードユニット８２０に載置されたカセット８２０ａから取り出された半導体基板は、第１アライナ兼膜厚測定ユニット８４１内に被めっき面を上にして配置される。ここで、膜厚計測を行うポジションの基準点を定めるために、膜厚計測用のノッチアライメントを行った後、銅膜形成前の半導体基板の膜厚データを得る。

【００８６】次に、半導体基板は、第１ロボット８３１により、バリア層成膜ユニット８１１へ搬送される。このバリア層成膜ユニット８１１は、無電解Ｒｕめっきにより半導体基板上にバリア層を形成する装置で、半導体装置の層間絶縁膜（例えば、SiO_2）への銅拡散防止膜としてＲｕを成膜する。洗浄、乾燥工程を経て払い出された半導体基板は、第１ロボット８３１により第１アライナ兼膜厚測定ユニット８４１に搬送され、半導体基板の膜厚、即ちバリア層の膜厚を測定される。

【００８７】膜厚測定された半導体基板は、第２ロボット８３２でシード層成膜ユニット８１２へ搬入され、前記バリア層上に無電解銅めっきによりシード層が成膜される。洗浄、乾燥工程を経て払い出された半導体基板は、第２ロボット８３２により含浸めっきユニットであるめっきユニット８１３に搬送される前に、ノッチ位置を定めるために第２アライナ兼膜厚測定器８４２に搬送され、銅めっき用のノッチのアライメントを行う。ここで、必要に応じて銅膜形成前の半導体基板の膜厚を再計測してもよい。

【００８８】ノッチアライメントが完了した半導体基板は、第３ロボット８３３によりめっきユニット８１３へ搬送され、銅めっきが施される。洗浄、乾燥工程を経て払い出された半導体基板は、第３ロボット８３３により半導体基板端部の不要な銅膜（シード層）を除去するためにベベル・裏面洗浄ユニット８１６へ搬送される。ベベル・裏面洗浄ユニット８１６では、予め設定された時間でベベルのエッチングを行うとともに、半導体基板裏面に付着した銅をフッ酸等の薬液により洗浄する。この時、ベベル・裏面洗浄ユニット８１６へ搬送する前に、第２アライナ兼膜厚測定器８４２にて半導体基板の膜厚測定を実施して、めっきにより形成された銅膜厚の値を得ておき、その結果により、ベベルのエッチング時間を任意に変えてエッチングを行っても良い。なお、ベベルエッチングによりエッチングされる領域は、基板の周縁部であって回路が形成されない領域、または回路が形成されていても最終的にチップとして利用されない領域である。この領域にはベベル部分が含まれる。

【００８９】ベベル・裏面洗浄ユニット８１６で洗浄、乾燥工程を経て払い出された半導体基板は、第３ロボット８３３で基板反転機８４３に搬送され、該基板反転機８４３にて反転され、被めっき面を下方に向けた後、第４ロボット８３４により配線部を安定化させるためにアニールユニット８１４へ投入される。アニール処理前及び／又は処理後、第２アライナ兼膜厚測定ユニット８４２に搬入し、半導体基板に形成された、銅膜の膜厚を計測する。この後、半導体基板は、第４ロボット８３４により第１ポリッシング装置８２１に搬入され、半導体基板の銅層、シード層の研磨を行う。

【００９０】この際、砥粒等は所望のものが用いられるが、ディッシングを防ぎ、表面の平面度を出すために、固定砥粒を用いることもできる。第１ポリッシング終了後、半導体基板は、第４ロボット８３４により第１洗浄ユニット８１５に搬送され、洗浄される。この洗浄は、半導体基板直径とほぼ同じ長さを有するロールを半導体基板の表面と裏面に配置し、半導体基板及びロールを回転させつつ、純水又は脱イオン水を流しながら洗浄するスクラブ洗浄である。

【００９１】第１の洗浄終了後、半導体基板は、第４ロボット８３４により第２ポリッシング装置８２２に搬入され、半導体基板上のバリア層が研磨される。この際、砥粒等は所望のものが用いられるが、ディッシングを防ぎ、表面の平面度を出すために、固定砥粒を用いることもできる。第２ポリッシング終了後、半導体基板は、第４ロボット８３４により、再度第１洗浄ユニット８１５に搬送され、スクラブ洗浄される。洗浄終了後、半導体基板は、第４ロボット８３４により第２基板反転機８４４に搬送され反転されて、被めっき面を上方に向けられ、更に第３ロボット８３３により基板仮置き台８４５に置かれる。

【００９２】半導体基板は、第２ロボット８３２により基板仮置き台８４５から蓋めっきユニット８１７に搬送され、銅の大気による酸化防止を目的に銅面上にニッケル・ボロンめっきを行う。蓋めっきが施された半導体基板は、第２ロボット８３２により蓋めっきユニット８１７から第３膜厚測定器８４６に搬入され、銅膜厚が測定される。その後、半導体基板は、第１ロボット８３１により第２洗浄ユニット８１８に搬入され、純水又は脱イオン水により洗浄される。洗浄が終了した半導体基板は、台１ロボット８３１によりロード・アンロード部８

２０に載置されたカセット８２０ａ内に戻される。アライナ兼膜厚測定器８４１及びアライナ兼膜厚測定器８４２は、基板ノッチ部分の位置決め及び膜厚の測定を行う。

【００９３】ベベル・裏面洗浄ユニット８１６は、エッジ（ベベル）銅エッチングと裏面洗浄が同時に行え、また基板表面の回路形成部の銅の自然酸化膜の成長を抑えることが可能である。図１９に、ベベル・裏面洗浄ユニット８１６の概略図を示す。図１９に示すように、ベベル・裏面洗浄ユニット８１６は、有底円筒状の防水カバー９２０の内部に位置して基板Ｗをフェイスアップでその周縁部の円周方向に沿った複数箇所でスピンチャック９２１により水平に保持して高速回転させる基板保持部９２２と、この基板保持部９２２で保持された基板Ｗの表面側のほぼ中央部上方に配置されたセンタノズル９２４と、基板Ｗの周縁部の上方に配置されたエッジノズル９２６とを備えている。センタノズル９２４及びエッジノズル９２６は、それぞれ下向きで配置されている。また基板Ｗの裏面側のほぼ中央部の下方に位置して、バックノズル９２８が上向きで配置されている。前記エッジノズル９２６は、基板Ｗの直径方向及び高さ方向を移動自在に構成されている。

【００９４】このエッジノズル９２６の移動幅Ｌは、基板の外周端面から中心部方向に任意の位置決めが可能になっていて、基板Ｗの大きさや使用目的等に合わせて、設定値の入力を行う。通常、２ｍｍから５ｍｍの範囲でエッジカット幅Ｃを設定し、裏面から表面への液の回り込み量が問題にならない回転数以上であれば、その設定されたカット幅Ｃ内の銅膜を除去することができる。

【００９５】次に、この洗浄装置による洗浄方法について説明する。まず、スピンチャック９２１を介して基板を基板保持部９２２で水平に保持した状態で、半導体基板Ｗを基板保持部９２２と一体に水平回転させる。この状態で、センタノズル９２４から基板Ｗの表面側の中央部に酸溶液を供給する。この酸溶液としては非酸化性の酸であればよく、例えばフッ酸、塩酸、硫酸、クエン酸、蓚酸等を用いる。一方、エッジノズル９２６から基板Ｗの周縁部に酸化剤溶液を連続的または間欠的に供給する。この酸化剤溶液としては、オゾン水、過酸化水素水、硝酸水、次亜塩素酸ナトリウム水等のいずれかを用いるか、またはそれらの組み合わせを用いる。

【００９６】これにより、半導体基板Ｗの周縁部のエッジカット幅Ｃの領域では上面及び端面に成膜された銅膜等は酸化剤溶液で急速に酸化され、同時にセンタノズル９２４から供給されて基板の表面全面に拡がる酸溶液によってエッチングされ溶解除去される。このように、基板周縁部で酸溶液と酸化剤溶液を混合させることで、予めそれらの混合水をノズルから供給するのに比べて急峻なエッチングプロフィールを得ることができる。このときそれらの濃度により銅のエッチングレートが決定される。また、基板の表面の回路形成部に銅の自然酸化膜が形成されていた場合、この自然酸化物は基板の回転に伴って基板の表面全面に亘って広がる酸溶液で直ちに除去されて成長することはない。なお、センタノズル９２４からの酸溶液の供給を停止した後、エッジノズル９２６からの酸化剤溶液の供給を停止することで、表面に露出しているシリコンを酸化して、銅の付着を抑制することができる。

【００９７】一方、バックノズル９２８から基板の裏面中央部に酸化剤溶液とシリコン酸化膜エッチング剤とを同時または交互に供給する。これにより半導体基板Ｗの裏面側に金属状で付着している銅等を基板のシリコンごと酸化剤溶液で酸化しシリコン酸化膜エッチング剤でエッチングして除去することができる。なおこの酸化剤溶液としては表面に供給する酸化剤溶液と同じものにする方が薬品の種類を少なくする上で好ましい。またシリコン酸化膜エッチング剤としては、フッ酸を用いることができ、基板の表面側の酸溶液もフッ酸を用いると薬品の種類を少なくすることができる。これにより、酸化剤供給を先に停止すれば疎水面が得られ、エッチング剤溶液を先に停止すれば飽水面（親水面）が得られて、その後のプロセスの要求に応じた裏面に調整することもできる。

【００９８】このように酸溶液すなわちエッチング液を基板に供給して、基板Ｗの表面に残留する金属イオンを除去した後、更に純水を供給して、純水置換を行ってエッチング液を除去し、その後、スピン乾燥を行う。このようにして半導体基板表面の周縁部のエッジカット幅Ｃ内の銅膜の除去と裏面の銅汚染除去を同時に行って、この処理を、例えば８０秒以内に完了させることができる。なお、エッジのエッジカット幅を任意（２ｍｍ～５ｍｍ）に設定することが可能であるが、エッチングに要する時間はカット幅に依存しない。

【００９９】めっき後のＣＭＰ工程前に、アニール処理を行うことが、この後のＣＭＰ処理や配線の電気特性に対して良い効果を示す。アニール無しでＣＭＰ処理後に幅の広い配線（数μｍ単位）の表面を観察するとマイクロボイドのような欠陥が多数見られ、配線全体の電気抵抗を増加させたが、アニールを行うことでこの電気抵抗の増加は改善された。アニール無しの場合に、細い配線にはボイドが見られなかったことより、粒成長の度合いが関わっていることが考えられる。つまり、細い配線では粒成長が起こりにくいが、幅の広い配線では粒成長に伴い、アニール処理に伴うグレン成長の過程で、めっき膜中のＳＥＭ（走査型電子顕微鏡）でも見えないほどの超微細ポアが集結しつつ上へ移動することで配線上部にマイクロボイド用の凹みが生じたという推測ができる。アニールユニットのアニール条件としては、ガスの雰囲気は水素を添加（２％以下）、温度は３００～４００℃程度で１～５分間で上記の効果が得られた。

【0100】図22及び図23は、アニールユニット814を示すものである。このアニールユニット814は、半導体基板Wを出し入れするゲート1000を有するチャンバ1002の内部に位置して、半導体基板Wを、例えば400℃に加熱するホットプレート1004と、例えば冷却水を流して半導体基板Wを冷却するクールプレート1006が上下に配置されている。また、クールプレート1006の内部を貫通して上下方向に延び、上端に半導体基板Wを載置保持する複数の昇降ピン1008が昇降自在に配置されている。更に、アニール時に半導体基板Wとホットプレート1008との間に酸化防止用のガスを導入するガス導入管1010と、該ガス導入管1010から導入され、半導体基板Wとホットプレート1004との間を流れたガスを排気するガス排気管1012がホットプレート1004を挟んで互いに対峙する位置に配置されている。

【0101】ガス導入管1010は、内部にフィルタ1014aを有するN_2ガス導入路1016内を流れるN_2ガスと、内部にフィルタ1014bを有するH_2ガス導入路1018内を流れるH_2ガスとを混合器1020で混合し、この混合器1020で混合したガスが流れる混合ガス導入路1022に接続されている。

【0102】これにより、ゲート1000を通じてチャンバ1002の内部に搬入した半導体基板Wを昇降ピン1008で保持し、昇降ピン1008を該昇降ピン1008で保持した半導体基板Wとホットプレート1004との距離が、例えば0.1～1.0mm程度となるまで上昇させる。この状態で、ホットプレート1004を介して半導体基板Wを、例えば400℃となるように加熱し、同時にガス導入管1010から酸化防止用のガスを導入して半導体基板Wとホットプレート1004との間を流してガス排気管1012から排気する。これによって、酸化を防止しつつ半導体基板Wをアニールし、このアニールを、例えば数十秒～60秒程度継続してアニールを終了する。基板の加熱温度は100～600℃が選択される。

【0103】アニール終了後、昇降ピン1008を該昇降ピン1008で保持した半導体基板Wとクールプレート1006との距離が、例えば0～0.5mm程度となるまで下降させる。この状態で、クールプレート1006内に冷却水を導入することで、半導体基板Wの温度が100℃以下となるまで、例えば10～60秒程度、半導体基板を冷却し、この冷却終了後の半導体基板を次工程に搬送する。なお、この例では、酸化防止用のガスとして、N_2ガスと数%のH_2ガスを混合した混合ガスを流すようにしているが、N_2ガスのみを流すようにしてもよい。

【0104】図20は、無電解めっき装置の概略構成図である。図20に示すように、この無電解めっき装置は、被めっき部材である半導体基板Wをその上面に保持する保持手段911と、保持手段911に保持された半導体基板Wの被めっき面(上面)の周縁部に当接して該周縁部をシールする堰部材931と、堰部材931でその周縁部をシールされた半導体基板Wの被めっき面にめっき液を供給するシャワーヘッド941を備えている。無電解めっき装置は、さらに保持手段911の上部外周近傍に設置されて半導体基板Wの被めっき面に洗浄液を供給する洗浄液供給手段951と、排出された洗浄液等(めっき廃液)を回収する回収容器961と、半導体基板W上に保持しためっき液を吸引して回収するめっき液回収ノズル965と、前記保持手段911を回転駆動するモータMとを備えている。以下、各部材について説明する。

【0105】保持手段911は、その上面に半導体基板Wを載置して保持する基板載置部913を設けている。この基板載置部913は、半導体基板Wを載置して固定するように構成されており、具体的には半導体基板Wをその裏面側に真空吸着する図示しない真空吸着機構を設置している。一方、基板載置部913の裏面側には、面状であって半導体基板Wの被めっき面を下面側から暖めて保温する裏面ヒータ915が設置されている。この裏面ヒータ915は、例えばラバーヒータによって構成されている。この保持手段911は、モータMによって回転駆動されると共に、図示しない昇降手段によって上下動できるように構成されている。堰部材931は、筒状であってその下部に半導体基板Wの外周縁をシールするシール部933を設け、図示の位置から上下動しないように設置されている。

【0106】シャワーヘッド941は、先端に多数のノズルを設けることで、供給されためっき液をシャワー状に分散して半導体基板Wの被めっき面に略均一に供給する構造のものである。また洗浄液供給手段951は、ノズル953から洗浄液を噴出する構造である。めっき液回収ノズル965は、上下動且つ旋回できるように構成されていて、その先端が半導体基板Wの上面周縁部の堰部材931の内側に下降して半導体基板W上のめっき液を吸引するように構成されている。

【0107】次に、この無電解めっき装置の動作を説明する。まず図示の状態よりも保持手段911を下降して堰部材931との間に所定寸法の隙間を設け、基板載置部913に半導体基板Wを載置・固定する。半導体基板Wとしては例えばφ8インチ基板を用いる。次に、保持手段911を上昇して図示のようにその上面を堰部材931の下面に当接させ、同時に半導体基板Wの外周を堰部材931のシール部933によってシールする。このとき半導体基板Wの表面は開放された状態となっている。

【0108】次に、裏面ヒータ915によって半導体基板W自体を直接加熱して、例えば半導体基板Wの温度を70℃にし(めっき終了まで維持する)、次に、シャワ

ーヘッド９４１から、例えば５０℃に加熱されためっき液を噴出して半導体基板Wの表面の略全体にめっき液を降り注ぐ。半導体基板Wの表面は、堰部材９３１によって囲まれているので、注入しためっき液は全て半導体基板Wの表面に保持される。供給するめっき液の量は、半導体基板Wの表面に１mm厚（約３０ｍｌ）となる程度の少量で良い。なお被めっき面上に保持するめっき液の深さは１０mm以下であれば良く、この例のように１ｍｍでも良い。この例のように供給するめっき液が少量で済めばこれを加熱する加熱装置も小型のもので良くなる。そしてこの例においては、半導体基板Wの温度を７０℃に、めっき液の温度を５０℃に加熱しているので、半導体基板Wの被めっき面は例えば６０℃になり、この例におけるめっき反応に最適な温度にできる。このように半導体基板W自体を加熱するように構成すれば、加熱するのに大きな消費電力の必要なめっき液の温度をそれほど高く昇温しなくても良いので、消費電力の低減化やめっき液の材質変化の防止が図れ、好適である。なお半導体基板W自体の加熱のための消費電力は小さくて良く、また半導体基板W上に溜めるめっき液の量は少ないので、裏面ヒータ９１５による半導体基板Wの保温は容易に行え、裏面ヒータ９１５の容量は小さくて良く装置のコンパクト化を図ることができる。また半導体基板W自体を直接冷却する手段を用いれば、めっき中に加熱・冷却を切替えてめっき条件を変化させることも可能である。半導体基板上に保持されているめっき液は少量なので、感度良く温度制御が行える。

【０１０９】そして、モータMによって半導体基板Wを瞬時回転させて被めっき面の均一な液濡れを行い、その後半導体基板Wを静止した状態で被めっき面のめっきを行う。具体的には、半導体基板Wを１ｓｅｃだけ１００ｒｐｍ以下で回転して半導体基板Wの被めっき面上をめっき液で均一に濡らし、その後静止させて１ｍｉｎ間無電解めっきを行わせる。なお瞬時回転時間は長くても１０ｓｅｃ以下とする。

【０１１０】上記めっき処理が完了した後、めっき液回収ノズル９６５の先端を半導体基板Wの表面周縁部の堰部材９３１の内側近傍に下降し、めっき液を吸い込む。このとき半導体基板Wを例えば１００ｒｐｍ以下の回転速度で回転させれば、半導体基板W上に残っためっき液を遠心力で半導体基板Wの周縁部の堰部材９３１の部分に集めることができ、効率良く、且つ高い回収率でめっき液の回収ができる。そして保持手段９１１を下降させて半導体基板Wを堰部材９３１から離し、半導体基板Wの回転を開始して洗浄液供給手段９５１のノズル９５３から洗浄液（超純水）を半導体基板Wの被めっき面に噴射して被めっき面を冷却すると同時に希釈化・洗浄することで無電解めっき反応を停止させる。このときノズル９５３から噴射される洗浄液を堰部材９３１にも当てることで堰部材９３１の洗浄を同時に行っても良い。このときのめっき廃液は、回収容器９６１に回収され、廃棄される。

【０１１１】なお、一度使用しためっき液は再利用せず、使い捨てとする。前述のようにこの装置において使用されるめっき液の量は従来に比べて非常に少なくできるので、再利用しなくても廃棄するめっき液の量は少ない。なお場合によってはめっき液回収ノズル９６５を設置しないで、使用後のめっき液も洗浄液と共にめっき廃液として回収容器９６１に回収しても良い。そしてモータMによって半導体基板Wを高速回転してスピン乾燥した後、保持手段９１１から取り出す。

【０１１２】図２１は、他の無電解めっき装置の概略構成図である。図２１において、前記の例と相違する点は、保持手段９１１内に裏面ヒータ９１５を設ける代わりに、保持手段９１１の上方にランプヒータ（加熱手段）９１７を設置し、このランプヒータ９１７とシャワーヘッド９４１－２とを一体化した点である。即ち、例えば複数の半径の異なるリング状のランプヒータ９１７を同心円状に設置し、ランプヒータ９１７の間の隙間からシャワーヘッド９４１－２の多数のノズル９４３－２をリング状に開口させている。なおランプヒータ９１７としては、渦巻状の一本のランプヒータで構成しても良いし、さらにそれ以外の各種構造・配置のランプヒータで構成しても良い。

【０１１３】このように構成しても、めっき液は、各ノズル９４３－２から半導体基板Wの被めっき面上にシャワー状に略均等に供給でき、またランプヒータ９１７によって半導体基板Wの加熱・保温も直接均一に行える。ランプヒータ９１７の場合、半導体基板Wとめっき液の他に、その周囲の空気をも加熱するので半導体基板Wの保温効果もある。

【０１１４】なおランプヒータ９１７によって半導体基板Wを直接加熱するには、比較的大きい消費電力のランプヒータ９１７が必要になるので、その代わりに比較的小さい消費電力のランプヒータ９１７と前記図２０に示す裏面ヒータ９１５とを併用して、半導体基板Wは主として裏面ヒータ９１５によって加熱し、めっき液と周囲の空気の保温は主としてランプヒータ９１７によって行うようにしても良い。また前述の実施例と同様に、半導体基板Wを直接、または間接的に冷却する手段をも設けて、温度制御を行っても良い。

【０１１５】

【発明の効果】以上説明したように、本発明によれば、めっきの進行によるアノードの溶解に伴って、実際の極間距離（アノードとカソードとなる被めっき面との距離）が徐々に変化（大きくなる）しても、基板とアノードとの間に位置する整流板の表面を仮の陽極（擬似アノード）として作用させて、見かけ上の極間距離（整流板とカソードとなる被めっき面との距離）を常に一定となし、これによって、アノードとして溶解性のものを使用

しても、めっき膜の面内均一性が経時的に変化することを防止することができる。

【図面の簡単な説明】

【図１】めっき槽内の陰極（カソード）と陽極（アノード）との間に膜を配置した時に、この膜の表面があたかもアノードであるかの如く電場が形成されるのを見いだした時に使用しためっき装置を示す概要図である。

【図２】図１に示すめっき装置を使用して形成しためっき膜の膜厚分布を測定した結果を示すグラフである。

【図３】図１に示すめっき装置から膜を除いて形成しためっき膜の膜厚分布を測定した結果を示すグラフである。

【図４】本発明の実施の形態のめっき装置の概要を示す断面図である。

【図５】基板処理装置を示す平面配置図である。

【図６】図５に示す基板処理装置内の気流の流れを示す図である。

【図７】図５に示す基板処理装置の各エリア間の空気の流れを示す図である。

【図８】図５に示す基板処理装置をクリーンルーム内に配置した一例を示す外観図である。

【図９】基板処理装置の他の例を示す平面配置図である。

【図１０】基板処理装置の更に他の例を示す平面配置図である。

【図１１】基板処理装置の更に他の例を示す平面配置図である。

【図１２】基板処理装置の更に他の例を示す平面配置図である。

【図１３】基板処理装置の更に他の例を示す平面配置図である。

【図１４】基板処理装置の更に他の例を示す平面配置図である。

【図１５】基板処理装置の更に他の例を示す平面配置図である。

【図１６】基板処理装置の更に他の例を示す平面配置図である。

【図１７】基板処理装置の更に他の例を示す平面配置図である。

【図１８】図１７に示す基板処置装置における各工程の流れを示すフローチャートである。

【図１９】ベベル・裏面洗浄ユニットを示す概要図である。

【図２０】無電解めっき装置の一例を示す概要図である。

【図２１】無電解めっき装置の他の例を示す概要図である。

【図２２】アニールユニットの一例を示す縦断正面図である。

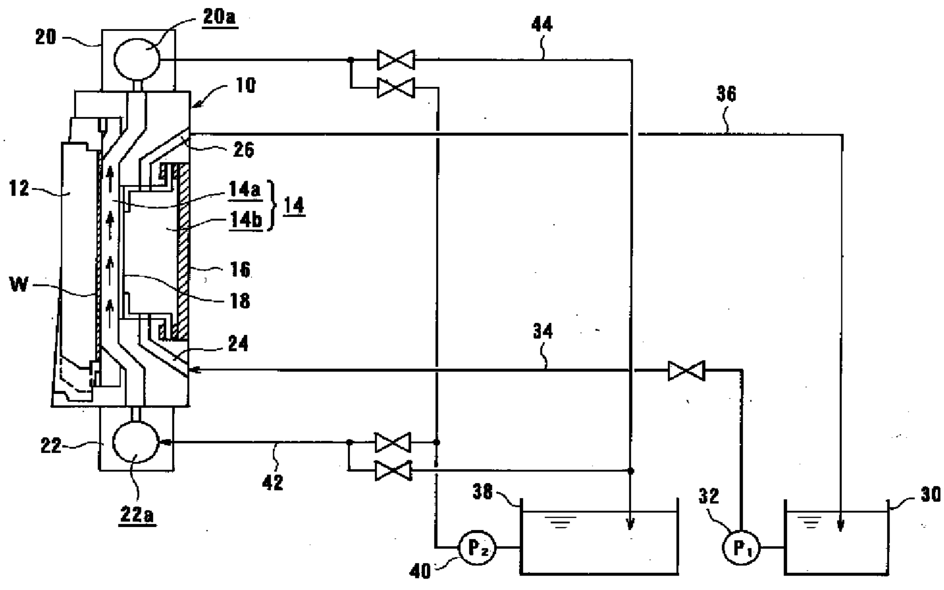
【図２３】図２２の平断面図である。

【図２４】銅めっきにより銅配線を形成する例を工程順に示す図である。

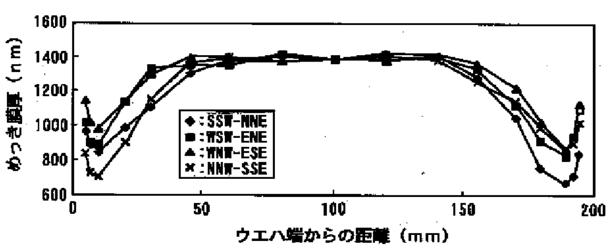
【符号の説明】

１０　めっき槽
１２　側板
１４　めっき室
１４ａ　基板側領域
１４ｂ　アノード側領域
１６　アノード
１８　カチオン交換膜
３０，３８　めっき液タンク
３２，４０　ポンプ
５０　めっき槽
５２　基板ホルダ
５４　アノード
５６　めっき室
５６ａ　基板側領域
５６ｂ　アノード側領域
５８　周壁
６０　めっき液噴射ノズル
６２　めっき液供給路
６４　めっき液排出路
６６，６６　めっき液排出路
６８　整流板
７０　パンチプレート
７２　ハウジング
７４　押圧リング
７６　モータ
７８　シリンダ
８２　基板保持部
８４　シール材
８６　カソード電極用接点

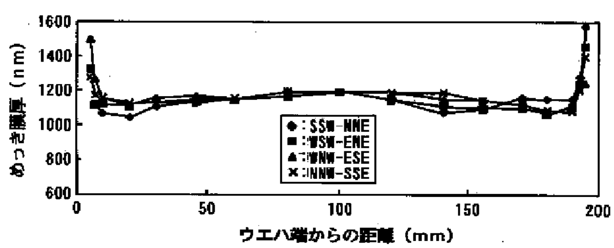
【図1】


20a
20
44
10
36
26
12
14a
14b
14
16
W
18
24
34
22
42
22a
38
32
30
P2
P1
40

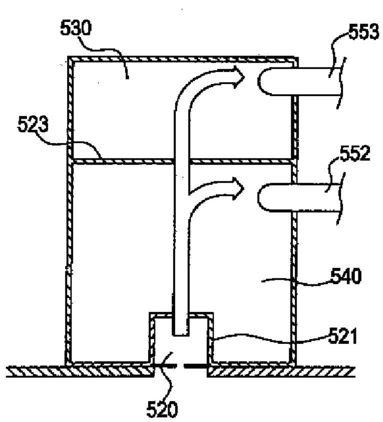
【図2】


めっき膜厚 (nm)
ウエハ端からの距離 (mm)
◆:SSW-NNE
■:WSW-ENE
▲:WNW-ESE
×:NNW-SSE

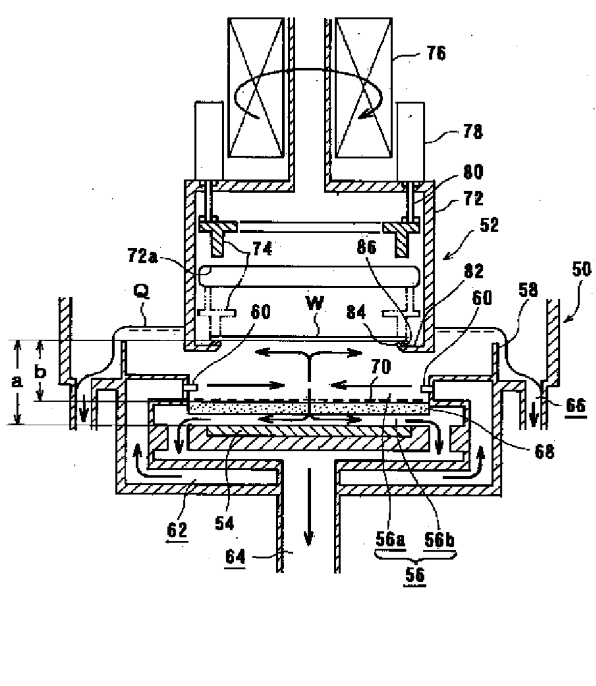
【図3】


めっき膜厚 (nm)
ウエハ端からの距離 (mm)
◆:SSW-NNE
■:WSW-ENE
▲:WNW-ESE
×:NNW-SSE

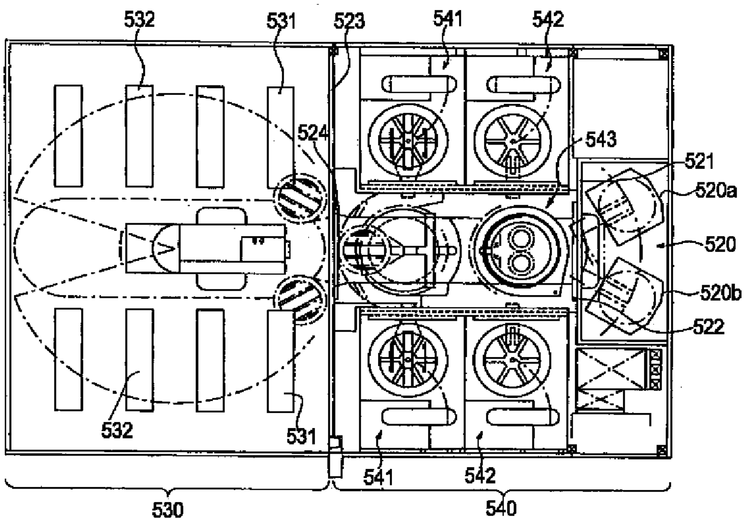
【図7】


530
553
523
552
540
521
520

【図4】


76
78
80
72
52
72a
74
86
82
50
Q
60
W
84
60
58
a
b
70
66
68
62
54
64
56a
56b
56

【図5】



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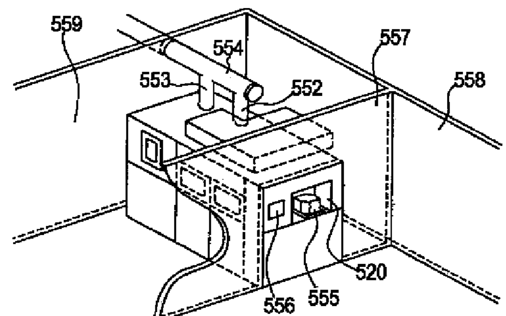

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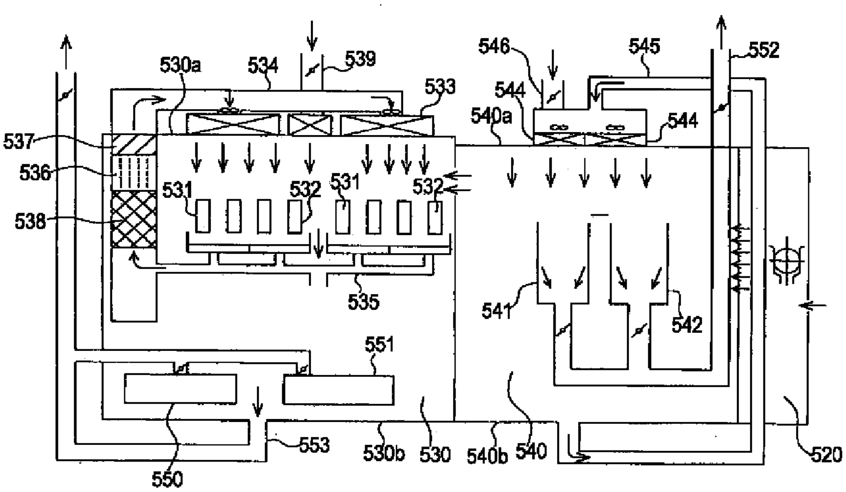

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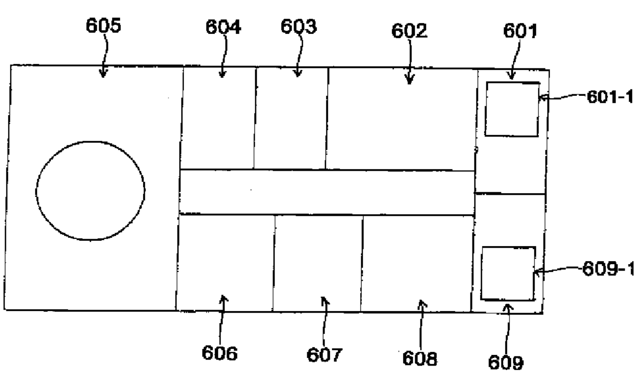
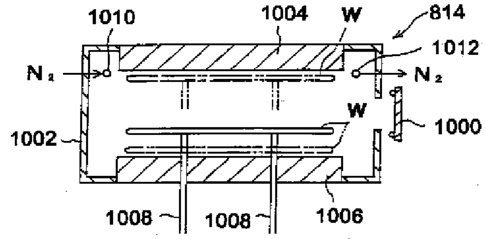


【図２２】



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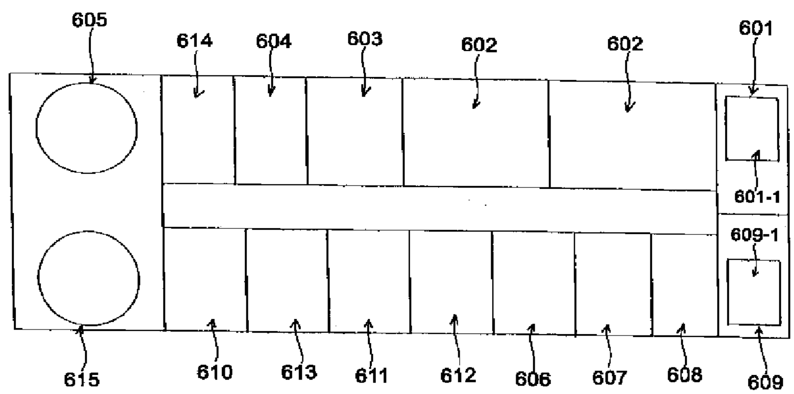

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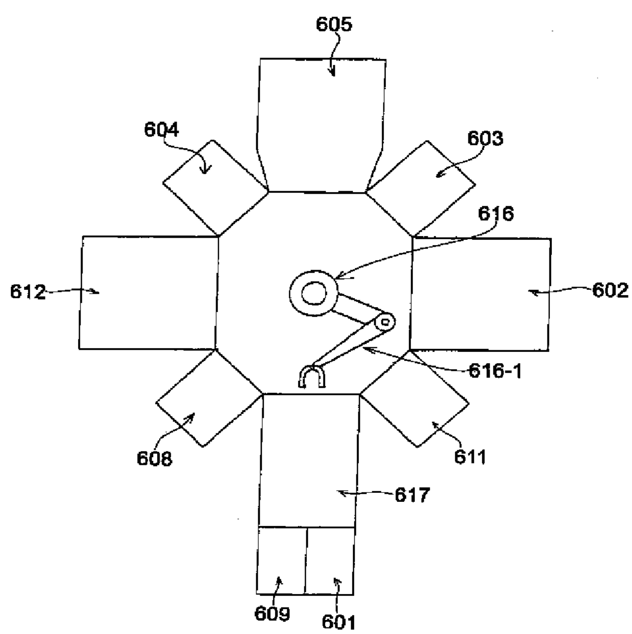

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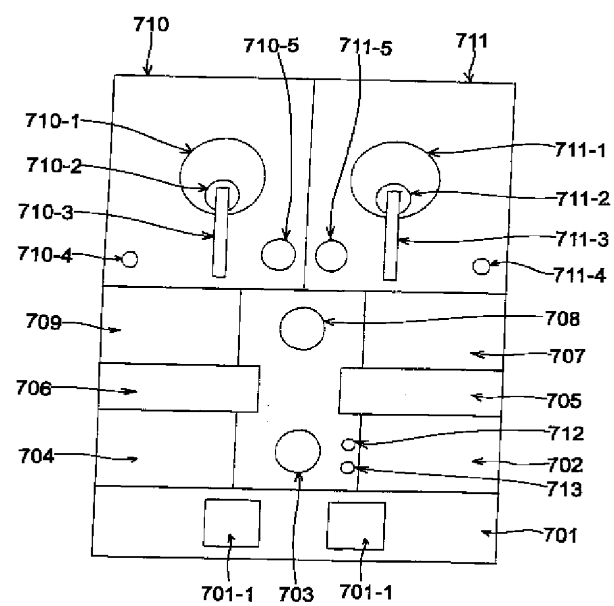

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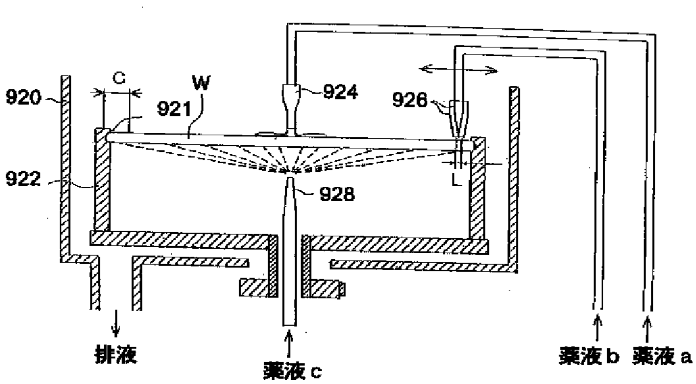

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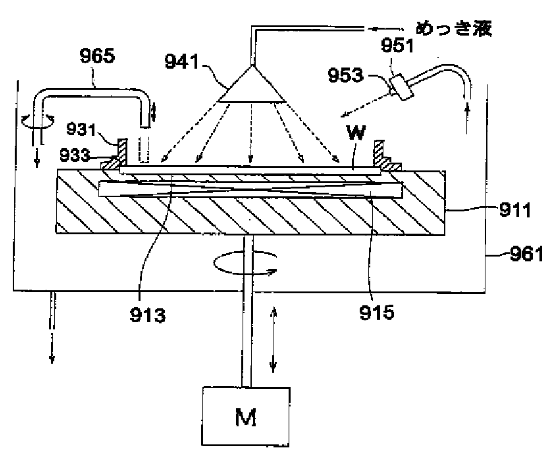

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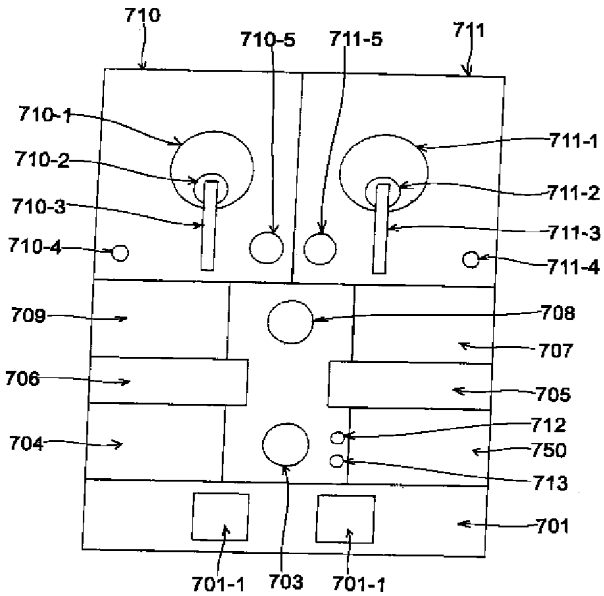

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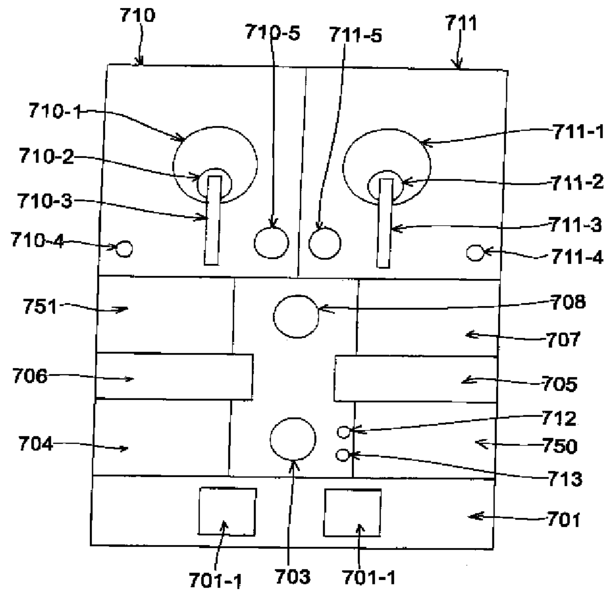

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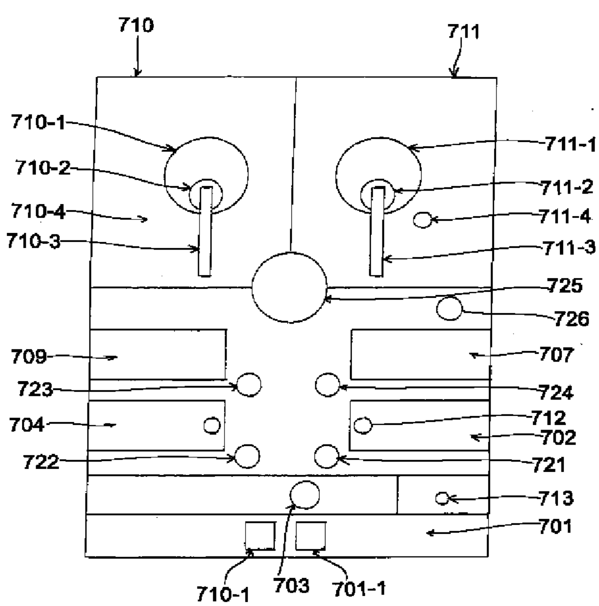

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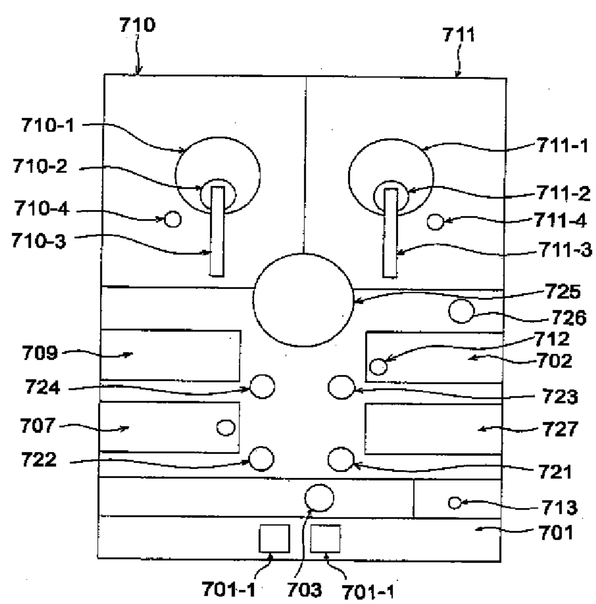
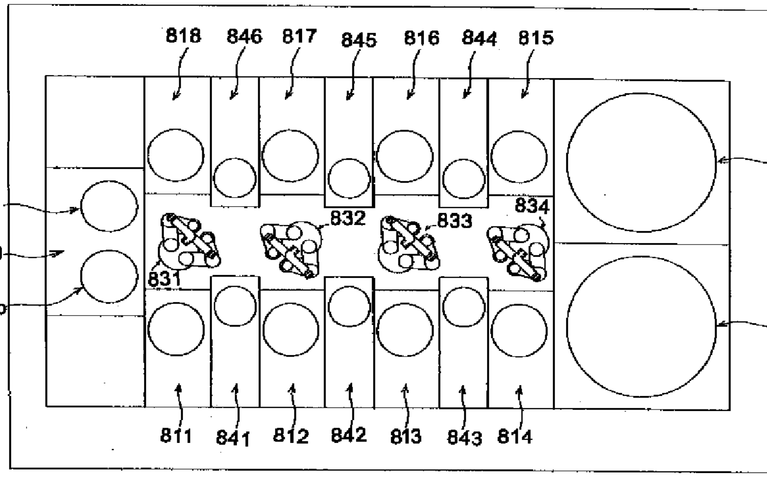
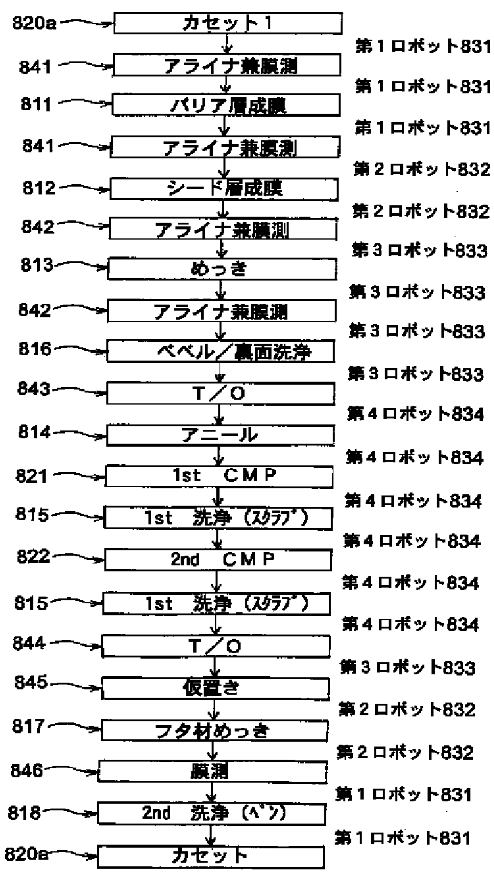


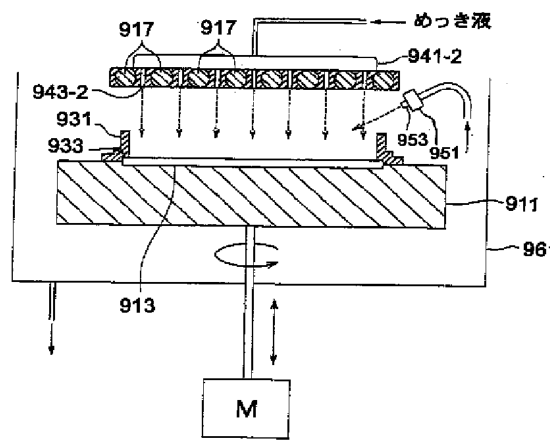
【図17】


818
846
817
845
816
844
815
822
820a
820
820b
832
833
834
831
821
811
841
812
842
813
843
814

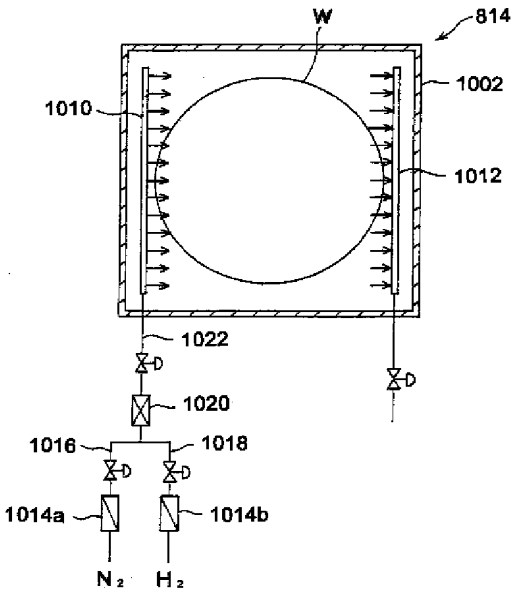
【図18】


820a カセット1
第1ロボット831
841 アライナ兼膜測
第1ロボット831
811 バリア層成膜
第1ロボット831
841 アライナ兼膜測
第2ロボット832
812 シード層成膜
第2ロボット832
842 アライナ兼膜測
第3ロボット833
813 めっき
第3ロボット833
842 アライナ兼膜測
第3ロボット833
816 ベベル／裏面洗浄
第3ロボット833
843 T／O
第4ロボット834
814 アニール
第4ロボット834
821 1st CMP
第4ロボット834
815 1st 洗浄（スクラブ）
第4ロボット834
822 2nd CMP
第4ロボット834
815 1st 洗浄（スクラブ）
第4ロボット834
844 T／O
第3ロボット833
845 仮置き
第2ロボット832
817 フタ材めっき
第2ロボット832
846 膜測
第1ロボット831
818 2nd 洗浄（ペン）
第1ロボット831
820a カセット

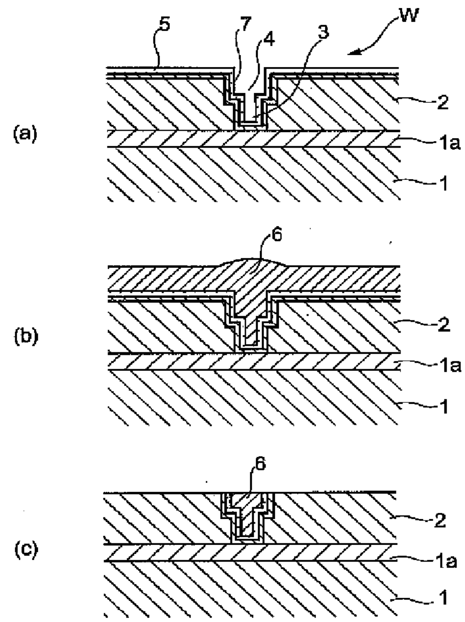
【図21】


917
917
めっき液
941-2
943-2
931
933
953
951
911
961
913
M

【図２３】



【図２４】



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		CB16 CB21 CB26 DB01 DB02			
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		HH01 HH05 HH14 HH16 HH20			

INFORMAL ENGLISH TRANSLATION OF JAPANESE REFERENCE NO. 2003-183892

TECHNICAL FIELD

[Field of the Invention]This invention relates to the plating device which performs metal plating, such as copper plating, to the surface (field to be plated) of substrates, such as a semiconductor wafer.

[Translation done.]

PRIOR ART

[Description of the Prior Art]In recent years, as a metallic material for forming a wiring circuit on a semiconductor substrate, it replaces with aluminum or an aluminum alloy, and the motion using copper (Cu) with high electromigration resistance with low electrical resistivity is remarkable. This kind of copper interconnect with techniques, such as CVD, sputtering, and plating. Generally it is formed of what is called a damascene process that embeds copper to the inside of the detailed dent of a substrate which formed copper on all the surfaces and was mostly provided in them on the surface of the substrate, and removes surplus copper by chemical machinery polish (CMP).
[0003]Drawing 24 (a) - (c) is what shows the example of manufacture of this kind of copper interconnect board W to process order, As shown in drawing 24 (a), the insulating layer 2 which consists of a SiO_2 oxide film, other Low-k material, etc. is deposited on the conductive layer 1a on the semiconductor base material 1 in which the semiconductor device was formed, The seed layer 7 is formed as a feeding layer of electrolysis plating the barrier layer 5 which forms the contact hole 3 and the slot 4 for wiring in the inside of this insulating layer 2, for example with lithography etching technology, and becomes it from TaN etc. on it, and also on it. As the barrier layer 5, a Ta/TaN mixed layer, TiN, WN, SiTiN, CoWP, CoWB, etc. are considered.
[0004]And as shown in drawing 24 (b), while filling up copper with giving copper plating to the surface of the substrate W in the contact hole 3 of the substrate W, and the slot 4 for wiring, the copper film 6 is deposited on the insulating layer 2. Then, by chemical machinery polish (CMP), the copper film 6 on the insulating layer 2 is removed, and the surface of the copper film 6 and the surface of the insulating layer 2 with which the contact hole 3 and the slot 4 for wiring were made to fill up are mostly made into the same flat surface. This forms the wiring which consists of the copper film 6, as shown in drawing 24 (c).
[0005]Here, in, for example, forming a copper layer on the surface of a substrate with electrolytic copper plating which uses a copper sulfate bath as a plating bath, generally, the soluble thing of the phosphorus-containing copper etc. which made copper contain Lynn is used as an anode. When this uses the thing of insolubility as an anode, supply of a copper ion is newly needed, The additive agent in plating liquid carries out oxidative degradation, and exhaust unusually automation of this supply is not only difficult, but, or, It is because the inside of the copper layer embedded to the inside of the detailed slot for wiring formed in the surface and this surface of a substrate by the oxygen to generate or a contact hole has a problem that a plating defect occurs.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention]As explained above, even if the actual distance between electrodes (distance with the field used as an anode and a cathode to be plated) changes gradually with the dissolution of the anode by advance of plating according to this invention (it becomes large), Make the surface of the current plate located between a substrate and an anode act as the temporary anode (false anode), and the distance between electrodes (distance with the field used as a current plate and a cathode to be plated) on appearance always as it is fixed by nothing and this. Even if it uses a soluble thing as an anode, the homogeneity within a field of a plating film can be prevented from changing temporally.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention]However, if electroplating is performed as an anode using soluble anodes, such as phosphorus-containing copper, The distance between electrodes (distance with the field of the substrate used as an anode and a cathode to be plated) will be changed because an anode dissolves with advance of plating, and the homogeneity within a field of the thickness of the plating film formed on the surface of a substrate will change temporally. The black film generated on the surface of an anode is omitted, the inside of plating liquid is floated, and there is also a problem of adhering as particle on the surface of a substrate. When the size of a semiconductor wafer becomes large, the diameter was also 300 mm and the flow of the plating liquid of a between is considered very much, it becomes difficult [it / to make the distance between electrodes small].
[0007]In view of the above, succeeded in this invention, and it uses a soluble anode as an anode, And the homogeneity within a field of the plating film formed in the field (surface) of a substrate to be plated aims at providing the plating device kept from changing temporally with the dissolution of the anode by advance of plating.

[Translation done.]

MEANS

[Means for Solving the Problem]A substrate holder which the invention according to claim 1 is arranged above a plating tub holding plating liquid, and said plating tub, places a field to be plated upside down, and holds a substrate enabling free attachment and detachment, A plating liquid spray nozzle which injects plating liquid horizontally towards a center from a periphery of said plating tub, It is a plating device having a current plate which is arranged down the flat surface which a plating liquid spray nozzle makes in the upper part of a soluble anode which made plating liquid immerse in said plating tub, and has been arranged, and said anode, and rectifies a flow of plating liquid.
[0009]By this, even if the actual distance between electrodes (distance with a field used as an anode and a cathode to be plated) changes gradually with the dissolution of an anode by advance of plating (it becomes large), The homogeneity within a field of a plating film is prevented from the surface of a current plate located between a substrate and an anode working as the temporary anode (false anode), and the distance between electrodes (distance with a field used as a current plate and a cathode to be plated) on appearance becoming always fixed for this reason, and changing temporally.
[0010]If a porous ion-exchange membrane used for polypropylene membrane used, for example for a filter material etc. or ionic exchange is arranged between the negative pole (cathode) in a plating tub, and the anode (anode), this, the surface of the film is an anode -- that -- it needs -- it is based on having found out that an electric field was formed. A result of having measured thickness distribution of a copper-plating film which formed by performing copper plating on the surface of a substrate (semiconductor wafer) using a plating device with which drawing 2 and drawing 3 show this drawing 1 a plating device which uses drawing 1 then is shown, respectively.

[0011]That is, as shown in drawing 1, this plating device is made to plate on the surface of a substrate (field to be plated) in ** about the substrate W, the plating tub 10 and the side plate 12 are provided, and the plating room 14 in which plating liquid is accommodated is formed in the plating tub 10. A lower end of the side plate 12 is connected with the lower part of the plating tub 10 via a hinge mechanism (not shown), and can open and close now an opening of the plating room 14 of the plating tub 10. The anode 16 of insolubility is formed in the side plate 12 of the plating tub 10, and a field of an opposite hand, and a field by the side of the plating tub 10 of the side plate 12 is equipped with the substrate W which plates a semiconductor wafer etc.
[0012]Where the side plate 12 is closed, the cation exchange membrane 18 is formed in an inside of the plating room 14 of the plating tub 10 so that it may be located between the substrate W and the anode 16, namely, so that the plating room 14 may be classified into the substrate side field 14a and the anode side field 14b (isolation). The upper header 20 and the lower header 22 are formed in the upper and lower sides of the plating tub 10, and the opening 20a of the upper header 20 and the opening 22a of the lower header 22 are open for free passage to the substrate

side field 14a. The plating liquid inlet 24 and the plating liquid port 26 which are open for free passage, respectively are established in the lower part and the upper part of the anode side field 14b at the plating tub 10.
[0013]And it extends from the 1st plating fluid tank 30, the 1st plating liquid introducing pipe 34 which infixed the 1st pump 32 in an inside is connected to the plating liquid inlet 24, and the 1st plating liquid exhaust pipe 36 prolonged from the 1st plating fluid tank 30 is connected to the plating liquid port 26. On the other hand, it extends from the 2nd plating fluid tank 38, the 2nd plating liquid introducing pipe 42 which infixed the 2nd pump 40 in an inside is connected to the lower header 22, and the 2nd plating liquid exhaust pipe 44 prolonged from the 2nd plating fluid tank 38 is connected to the upper header 20. With a drive of the 1st pump 32, plating liquid in the 1st plating fluid tank 30 is introduced in the anode side field 14b of the plating room 14 by this, and circulates by it, With a drive of the 2nd pump 40, plating liquid in the 2nd plating fluid tank 38 is introduced into the substrate side field 14a of the plating room 14, and circulates.
[0014]The side plate 12 is equipped with the substrate (semiconductor wafer) W with a diameter [in which the seed layer 7 (refer to drawing 24 (a)) was formed on the surface] of 200 mm in the above plating devices, It plated by introducing plating liquid into an inside of the plating room 14, impressing plating voltage between the seed layer 7 of this substrate W, and the anode 16. So that a direction of plating fluid pressure power in the anode side field 14b divided by the cation exchange membrane 18 of the plating room 14 may become higher than plating fluid pressure power in the substrate side field 14a at this time, Pump pressure P_1 of the 1st pump 32 was set up more highly ($P_1>P_2$) than pump pressure P_2 of the 2nd pump 40. Thus, a result of having measured thickness distribution of a formed plating film is shown in drawing 2. It turns out that thickness of a plating film is thick in the center section of the substrate W so that clearly from this drawing 2.
[0015]Next, in a device shown in drawing 1, it plated, where the cation exchange membrane 18 is deleted, and thickness distribution of a plating film formed with this plating was measured. A result at this time is shown in drawing 3. It turns out that thickness of a plating film is thick by a peripheral part of a substrate so that clearly from this drawing 3.
[0016]Thus, that data shown in drawing 2 was obtained although the actual distance between electrodes (distance of the seed layer 7 and the anode 16) had not changed, It is because the cation exchange membrane 18 curved toward the direction of the substrate W according to a pressure differential of the fields 14a and 14b of both sides which sandwiched this cation exchange membrane 18 and a center portion of the cation exchange membrane 18 approached the substrate W. It is a plating device shown in drawing 1, and if pump pressure P_1 of the 1st pump 32 is set up conversely lower ($P_1<P_2$) than pump pressure P_2 of the 2nd pump 40, it is confirmed that a substrate center section becomes thin.
[0017]Potential of the surface of cation exchange membrane shows a tendency which becomes equipotential in an operation of an electric field in plating liquid, and the surface of cation exchange membrane will commit this as the temporary anode. Even if a film is not an ion-exchange membrane, even if same result is obtained also with a neutral filter material and it is not a thin film, same result is obtained also for a non-conducting porous plate.
[0018]The invention according to claim 2 is the plating device according to claim 1 which said current plate is plate-like and is characterized by being arranged so that the whole surface of this anode may be covered to said anode and parallel. Thereby, while fixing current density [in / very / the whole surface of a between] on appearance, plating liquid introduced in a plating tub can flow smoothly along with a current plate. The invention according to claim 3 is the plating device according to claim 1 or 2, wherein said current plate comprises porous membrane of polypropylene, polyethylene, or PTFE, a porous board, or a porous board of ceramics.
[0019]The invention according to claim 4 density of said current plate, It is the plating device

according to any one of claims 1 to 3 setting as a size in which plating liquid turns an inside of a current plate caudad, passes with the prudence, and prevents the back run according to a flow of plating liquid introduced in a plating tub. It can be prevented from a black film generated on the surface of an anode flowing backwards a current plate, and reaching on the surface of a substrate by this. The invention according to claim 5 is the plating device according to claim 4, wherein density of said current plate is set as a size in which plating liquid of a flow of 1 - 5 L/min passes an inside of a current plate.

[0020]

[Embodiment of the Invention]Hereafter, an embodiment of the invention is described with reference to drawings. Drawing 4 shows the plating device of an embodiment of the invention. This plating device is approximately cylindrical and mainly comprises the plating tub 50 which accommodates the plating liquid Q in an inside, and the substrate holder 52 which is arranged above this plating tub 50 and holds the substrate W enabling free attachment and detachment. Drawing 1 shows the state when it is in the plating position which held the substrate W by the substrate holder 52, and raised the oil level of the plating liquid Q.

[0021]In the plating tub 50, it opens wide up, the soluble anodes 54, such as phosphorus-containing copper, are arranged at the pars basilaris ossis occipitalis, and it has the plating room 56 which holds the plating liquid Q inside. The plating liquid spray nozzle 60 which projects horizontally toward the center of the plating room 56 in the peripheral wall 58 which carries out section forming of the inner skin of the plating room 56 is arranged at equal intervals along with a circumferencial direction, and this plating liquid spray nozzle 60 is open for free passage to the plating liquid supply route 62 which carried out section forming to the peripheral part of the plating tub 50. This plating liquid supply route 62 is connected to the plating liquid feed pipe which is not illustrated.

[0022]The 2nd plating liquid exhaust passage 66 which discharges the plating liquid Q which overflowed the upper bed part of the peripheral wall 58 which carries out section forming of the 1st plating liquid exhaust passage 64 which draws out the plating liquid Q in the plating room 56 from the periphery of a pars basilaris ossis occipitalis of this plating room 56, and the inner skin of the plating room 56 is established in the plating tub 50. Such plating liquid exhaust passage 64 and 66 is connected to the plating liquid exhaust pipe which is not illustrated.

[0023]It is located in the inside of the plating room 56 of the plating tub 50 down the flat surface which is the upper part of the anode 54 and the plating liquid spray nozzle 60 makes, the current plate 68 is parallel to the anode 54, and it is arranged so that the whole surface of the anode 54 may be covered. The plating room 56 is classified into the substrate side field 56a and the anode side field 56b with the current plate 68 by this (isolation), and the plating liquid Q is introduced by this plating liquid spray nozzle 60 from this substrate side field 56a side.

[0024]This current plate 68 comprises porous membrane of polypropylene, polyethylene, or PTFE (polytetrafluoroethylene), a porous board, or a porous board of ceramics, for example. The density of this current plate 68 is set as the size in which the plating liquid Q turns the inside of the current plate 68 caudad, passes with that prudence, and prevents that back run according to the flow of the plating liquid Q introduced in the plating tub 50.

[0025]That is, the plating liquid Q which was injected from the plating liquid spray nozzle 60, and was introduced into the inside of the plating room 56 collides in the center section of the plating room 56, and is divided into the flow going up and the descending flow. And the flow which descended passes the inside of the current plate 68, flows along the surface of the anode 54, and is caudad discharged from the peripheral part of the anode 54. As for the flow at this time, about 1-5 L/min is desirable, for example, and in order for this flow not to have a back run moreover uniformly and to flow through the inside of the current plate 68, it is necessary to secure the channel corresponding to this flow. For this reason, in this example, by the gravity flow by the head of only the height of the oil level of the plating liquid Q located above the current plate 68,

the density of the current plate 68 is set up so that the plating liquid of 1 - 5 L/min may pass the inside of the current plate 68. It can be prevented from the black film generated by the surface of the anode 54 flowing backwards the inside of the current plate 68, and arriving at the surface of the substrate W by this.
[0026]The anode 54 made immersed into the plating liquid Q accommodated in the plating room 56 when this current plate 68 plated on the surface (field to be plated) of the substrate W held by the substrate holder 52, It is located between the surfaces (field to be plated) of the substrate contacted in the plating liquid Q in the plating room 56, and a role of the temporary anode (false anode) is played as mentioned above by this. By thus, the thing made for the current plate 68 to play a role of a false anode. Even if the actual distance between electrodes a, i.e., the distance of the anode 54 and the surface (field to be plated) of a substrate, becomes large gradually with the dissolution of the anode 54 by advance of plating, The distance between electrodes b on appearance, i.e., the distance of the surface of the current plate 68 and the surface (field to be plated) of a substrate, becomes always fixed, and the homogeneity within a field of the plating film formed by plating of this is prevented from changing temporally.
[0027]The current plate 68 is plate-like shape, and arranging in parallel with the substrate W is preferred. Thereby, while making regularity more current density [in / very / the whole surface of a between] on appearance, the plating liquid Q introduced in the plating room 56 of the plating tub 50 can flow smoothly along with the current plate 68. The path of a substrate becomes large, and in order to make the plating liquid injected from a plating liquid spray nozzle arrive at the center section of the plating room, even if it becomes impossible to bring the actual distance between electrodes close, it becomes possible by using a current plate as a false anode to make the apparent distance between electrodes small.
[0028]In this example, even if the punch plates 70 which established the hole of about 3-mm a large number in the upper position of the current plate 68, for example are arranged and the plating liquid Q flows backwards the inside of the current plate 68 by this, the black film formed in the surface of the anode 54 adheres to the substrate W. The punch plates 70 may be arranged to the downward position of the current plate 68, or may be built in a current plate, and do not need to provide a punching plate.
[0029]The housing 72 which has the opening 72a in a peripheral wall by the closed-end cylindrical shape which carried out the opening of the substrate holder 52 caudad, It has the press ring 74 arranged inside this housing 72, this housing 72 is connected with the output shaft of the motor 76, and the press ring 74 is connected with the cylinder rod 80 of the cylinder 78 attached downward at the housing 72. The substrate attaching part 82 of the ring shape which projects in an inner direction is formed in the lower end of the housing 72, and the sealant 84 of the ring shape in which it projects to an inner direction and a tip on top projects in the shape of a steeple up is attached to this substrate attaching part 82. Two or more points of contact 86 for cathode terminals are arranged outside this sealant 84 at the way.
[0030]Where the oil level of the plating liquid Q is lowered with this, after holding the substrate W by an adsorption hand etc., putting into the inside of the housing 72, laying in the upper surface of the sealant 84 of the substrate attaching part 82 and drawing out an adsorption hand from the housing 72, the press ring 74 is dropped. When the edge part of the substrate W is pinched on the undersurface of the sealant 84 and the press ring 74, the substrate W is held by this and the substrate W is moreover held, the undersurface and the sealant 84 of the substrate W weld by pressure, The seal of here is carried out certainly, the seed layer 7 (refer to drawing 24 (a) a) and the point of contact 86 for cathode terminals which were provided in the surface (field to be plated) of the substrate W energize simultaneously, and the seed layer 7 serves as a cathode.
[0031]Next, the plating processing by this plating device is explained. First, vacuum absorption is canceled, after inserting in this inside the substrate W which turned the surface downward and

carried out adsorption maintenance by a carrier robot's adsorption hand and this hand from the opening 72a of the housing 72 and moving an adsorption hand caudad, The substrate W is laid on the substrate attaching part 82 of the housing 72, and after an appropriate time, an adsorption hand is raised and it draws out from the housing 72. Next, the press ring 74 is dropped, the edge part of the substrate W is pinched on the undersurface of the substrate attaching part 82 and the press ring 74, and the substrate W is held.

[0032]And make the plating liquid Q inject from the plating liquid spray nozzle 60, and the housing 72 and the substrate W held at it are simultaneously rotated with medium speed, When several seconds pass, the plating liquid Q is filled to a predetermined quantity, and also it makes the revolving speed of the housing 72 fall to a low speed rotary (for example, $100min^{-1}$), and The anode 54, Between the seed layers 7 (refer to drawing 24 (a)) provided in the surface of the substrate W used as a cathode, a plating current is sent and electroplating is performed.

[0033]At this time, the current plate 68 plays a role of a false anode, and plating is governed as mentioned above, by the current density between the seed layers 7 provided in the surface of this current plate (false anode) 68 and the substrate W, and by this. Even if the anode 54 dissolves according to advance of plating, the distance between electrodes b on appearance, i.e., the distance of the surface of the current plate 68 and the surface (field to be plated) of a substrate, becomes always fixed, and the homogeneity within a field of the plating film formed by plating does not change temporally.

[0034]After ending plating, the plating liquid Q of the plating room 56 is drained, and the substrate W held at the housing 72 and it is exposed. In this state, the housing 72 and the substrate W held at it are rotated at high speed (for example, 500 - $800min^{-1}$), and the liquid end of the plating liquid is carried out according to a centrifugal force. After the liquid end is completed, as the housing 72 is suitable in the predetermined direction, rotation of the housing 72 is stopped.

[0035]After the housing 72 stops thoroughly, the press ring 74 is raised. Next, a carrier-robot adsorption hand etc. are turned downward, an adsorption face is inserted in this inside from the opening 72a of the housing 72, and an adsorption hand is dropped even to the position in which an adsorption hand can adsorb a substrate. And vacuum absorption of the substrate is carried out by an adsorption hand, an adsorption hand is moved to the upper part of the opening 72a of the housing 72, and an adsorption hand and the substrate held to it are taken out from the opening 72a of the housing 72.

[0036]Drawing 5 shows the plane configuration figure of the substrate processing device provided with the above-mentioned plating device. This substrate processing device possesses carrying-in / taking-out area 520 which delivers the substrate cassette which accommodated the semiconductor substrate, the process areas 530 which perform process treatment, and washing and drying area 540 which perform washing and desiccation of the semiconductor substrate after process treatment so that it may illustrate. Washing and the drying area 540 are arranged between carrying-in / taking-out area 520 and the process areas 530. The septum 521 was formed in carrying-in / taking-out area 520, and washing and drying area 540, and the septum 523 is formed between washing and the drying area 540, and the process areas 530.

[0037]The passage (not shown) for delivering a semiconductor substrate between carrying-in / taking-out area 520, and washing and drying area 540 was established in the septum 521, and the shutter 522 for opening and closing this passage is formed in it. The passage (not shown) for delivering a semiconductor substrate also to the septum 523 between washing and the drying area 540, and the process areas 530 was provided, and the shutter 524 for opening and closing this passage is formed. Washing and the drying area 540, and the process areas 530 have come to be able to carry out air supply and exhaust uniquely.

[0038]The substrate processing device for semiconductor substrate wiring of the above-

mentioned composition is installed in a clean room, and the pressure of each area is >(pressure of carrying-in / taking-out area 520) (pressure of washing and drying area 540) > (pressure of the process areas 530).
It is alike, and is set up and the pressure of carrying-in / taking-out area 520 is set up lower than clean room internal pressure. Keep air from flowing out of the process areas 530 into washing and the drying area 540, air is kept from flowing out of washing and the drying area 540 into carrying-in / taking-out area 520 by this, and air is kept from flowing out of carrying-in / taking-out area 520 in a clean room further.
[0039]The load unit 520a and the unloading unit 520b which store the substrate cassette which accommodated the semiconductor substrate in carrying-in / taking-out area 520 are arranged. Two sets each of the rinsing sections 541 and the dryer part 542 which perform processing after plating processing are arranged, and washing and the drying area 540 are equipped with the transportation part (carrier robot) 543 which conveys a semiconductor substrate. As the rinsing section 541, the pencil type thing and the thing of a roller-type type with sponge which sponge attached, for example to the front end are used here. The thing of form which carries out spin at high speed, dries and dries a semiconductor substrate as the dryer part 542, for example is used. In the process areas 530, the pretreatment tub 531 which pretreats plating of a semiconductor substrate, and the plating tub (plating device) 532 which performs copper plating treatment are arranged, and it has the transportation part (carrier robot) 533 which conveys a semiconductor substrate.
[0040]Drawing 6 shows the flow of the air current in a substrate processing device. In washing and the drying area 540, exterior air fresher than the piping 546 is incorporated, it is pushed in by a fan through the high efficiency filter 544, and the circumference of the rinsing section 541 and the dryer part 542 is supplied as a clean air of a downflow from the ceiling 540a. Most supplied clean airs are returned to the ceiling 540a side by the circulating piping 545 from the floor 540b, it is again pushed in by a fan through the high efficiency filter 544, and circulates in washing and the drying area 540. Some air currents are exhausted through the duct 552 from the inside of the rinsing section 541 and the dryer part 542.
[0041]Though the process areas 530 call it a wet zone, particle is not allowed to adhere to a semiconductor substrate surface. For this reason, particle is prevented from adhering to a semiconductor substrate by being pushed in by a fan and passing the clean air of a downflow through the high efficiency filter 533 from the ceiling 530a, in the process areas 530. However, when it depends on the air supply and exhaust from the outside for the full flow of the clean air which forms a downflow, the huge amount of air supply and exhaust is needed. For this reason, he considers only exhaust air of the grade which maintains the interior of a room at negative pressure as external exhaust air [duct / 553], and is trying to provide the air current of most downflows with the circulating current of air through the piping 534,535.
[0042]When it is considered as a circulating current of air, since the clean air which passed the process areas 530 contains drug solution mist and a gas, it removes this through the scrubber 536 and MITOSEPARETA 537,538. The exhaust air which returned to the circulation duct 534 by the side of the ceiling 530a by this becomes what contains neither drug solution mist nor a gas, is again pushed in by a fan, and it circulates through it as a clean air in the process areas 530 through the high efficiency filter 533. A part of exhaust air which passed along the inside of the process areas 530 from the floor 530b is discharged outside through the duct 553, and the exhaust air containing drug solution mist and a gas is discharged outside through the duct 553. From the duct 539 of the ceiling 530a, the fresh air corresponding to such displacement is supplied to the grade maintained at negative pressure in the process areas 530.
[0043]Each pressure of carrying-in / taking-out area 520, washing and drying area 540, and the process areas 530 is >(pressure of carrying-in / taking-out area 520) (pressure of washing and drying area 540) > (pressure of the process areas 530) as mentioned above.

It is alike and is set up. Therefore, if the shutter 522,524 (refer to drawing 5) is opened, the flow of the air between these area will flow in order of carrying-in / taking-out area 520, washing and drying area 540, and the process areas 530, as shown in drawing 6. Exhaust air lets the ducts 552 and 553 pass, and as shown in drawing 8, it is brought together in the set exhaust duct 554.

[0044]Drawing 7 is an outline view in which a substrate processing device shows an example arranged in a clean room. The side in which there are the cassette delivery mouth 555 of carrying-in / taking-out area 520 and the navigational panel 556 is exposed to the high working zone 558 of the air cleanliness class of the clean room divided with the bridge wall 557, and the other sides are stored by the low utility zone 559 of the air cleanliness class.

[0045]As mentioned above, washing and the drying area 540 are arranged between carrying-in / taking-out area 520 and the process areas 530, Since the septum 521 was formed, respectively between carrying-in / taking-out area 520, and washing and drying area 540 and between washing and the drying area 540, and the process areas 530, The semiconductor substrate carried in in the substrate processing device for semiconductor substrate wiring through the cassette delivery mouth 555 in the state where it dried, from the working zone 558, Since it is taken out in the working zone 558 in the state where plating processing was carried out, and it washed and dried within the substrate processing device, The high working zone 558 of the air cleanliness class in a clean room is not polluted with particle, a drug solution, or penetrant remover mist, without particle and mist adhering to a semiconductor substrate side.

[0046]Although the substrate processing device showed the example possessing carrying-in / taking-out area 520, washing and drying area 540, and the process areas 530 by drawing 5 and drawing 6, The area which adjoins the inside of the process areas 530 or the process areas 530, and arranges a CMP device may be provided, and it may constitute so that washing and the drying area 540 may be arranged between the area which arranges these process areas 530 or a CMP device, and carrying-in / taking-out area 520. What is necessary is just the composition discharged in the state where the semiconductor substrate was carried in to the substrate processing device for semiconductor substrate wiring by dryness in short, the semiconductor substrate which plating processing ended was washed, and it dried.

[0047]In the above-mentioned example, a substrate is not limited to a semiconductor substrate and a substrate processing device is not limited to the wiring section which was formed on the substrates face as for the portion which carries out plating processing, although the plating device for semiconductor substrate wiring was explained to the example. Although the above-mentioned example explained copper plating to the example, it is not limited to copper plating.

[0048]Drawing 9 is a figure showing the plane constitution of other substrate processing devices for semiconductor substrate wiring. So that it may illustrate the substrate processing device for semiconductor substrate wiring, A semiconductor substrate. The carrying out portion 609 which takes out the semiconductor substrate which the carrying in part 601 to carry in, the copper-plating tub 602 which performs copper plating, the rinse tank 603,604 which performs backwashing by water, the CMP section 605 which performs chemical machinery polish (CMP), the rinse tank 606,607, the dry tub 608, and wiring layer formation ended is provided, The substrate transporting means which transports a semiconductor substrate to these each tub and which is not illustrated is arranged as one device, and constitutes the substrate processing device for semiconductor substrate wiring.

[0049]In the substrate processing device of the above-mentioned arrangement configuration, by a substrate transporting means, the semiconductor substrate in which the wiring layer is not formed is taken out from the substrate cassette 601-1 laid in the carrying in part 601, and it transports to the copper-plating tub 602. In this copper-plating tub 602, a copper plating layer is formed on the surface of the semiconductor substrate W including the wiring section which consists of a wiring gutter or a wiring hole (contact hole).

[0050]It rinses by said copper plating layer 602 by transporting the semiconductor substrate W which formation of the copper plating layer ended to the rinse tank 603 and the rinse tank 604 by a substrate transporting means. Then, the semiconductor substrate W which this backwashing by water ended is transported to the CMP section 605 by a substrate transporting means, it leaves the copper plating layer formed in the wiring gutter or the wiring hole from the copper plating layer in this CMP section 605, and the copper plating layer on the surface of the semiconductor substrate W is removed.
[0051]Then, the semiconductor substrate W which left the copper plating layer formed in the wiring section which consists of a wiring gutter•or a wiring hole from the copper plating layer as mentioned above, and removal of the unnecessary copper plating layer on the surface of the semiconductor substrate W ended. Backwashing by water is sent and carried out to the rinse tank 606 and the rinse tank 607 by a substrate transporting means, and also the semiconductor substrate W which backwashing by water ended is dried by the dry tub 608, and the semiconductor substrate W which desiccation ended is stored in the substrate cassette 609-1 of the carrying out portion 609 as a semiconductor substrate which formation of the wiring layer ended.
[0052]Drawing 10 is a figure showing the plane constitution of other substrate processing devices for semiconductor substrate wiring. The point that the substrate processing device shown in drawing 10 differs from the device shown in drawing 9 is a point which added the copper-plating tub 602, the lid plating tub 612 which forms a protective film in the surface of a copper-plating film, the CMP section 615, and the rinse tanks 613 and 614, and was constituted as one device including these.
[0053]In the substrate processing device of the above-mentioned arrangement configuration, a copper plating layer is formed on the surface of the semiconductor substrate W including the wiring section which consists of a wiring gutter or a wiring hole (contact hole). Then, it leaves the copper plating layer formed in the wiring gutter or the wiring hole from the copper plating layer in the CMP section 605, and the copper plating layer on the surface of the semiconductor substrate W is removed.
[0054]Then, the semiconductor substrate W which left the copper plating layer formed in the wiring section which consists of a wiring gutter or a wiring hole from the copper plating layer as mentioned above, and removed the copper plating layer on the surface of the semiconductor substrate W is transported to the rinse tank 610, and backwashing by water is carried out here. Then, pretreatment for performing lid plating mentioned later by the pretreatment tub 611 is performed. The semiconductor substrate W which this pretreatment ended is transported to the lid plating tub 612, and a protective film is formed on the copper plating layer formed in the wiring section by the lid plating tub 612. As this protective film, a nickel-B nonelectrolytic plating tub is used, for example. After forming a protective film, backwashing by water of the semiconductor substrate W is carried out with the rinse tank 606,607, and also it is made to dry by the dry tub 608. And after grinding and carrying out flattening of the upper part of the protective film formed on the copper plating layer in the CMP section 615 and carrying out backwashing by water with the rinse tank 613,614, it is made to dry by the dry tub 608, and the semiconductor substrate W is stored in the substrate cassette 609-1 of the carrying out portion 609.
[0055]Drawing 11 is a figure showing the planar structure of other substrate processing devices for semiconductor substrate wiring. This substrate processing device arranges the robot 616 in the center so that it may illustrate, The copper-plating tub 602 which carries out copper plating to the range which the robot arm 616-1 of the circumference reaches, the rinse tank 603, the rinse tank 604, the CMP section 605, the lid plating tub 612, the dry tub 608, and the load unload part 617 are arranged, and it constitutes as one device. The load unload part 617 is adjoined and the carrying in part 601 and the carrying out portion 609 of the semiconductor substrate are

arranged.
[0056]In the substrate processing device for semiconductor substrate wiring of the above-mentioned composition, the semiconductor substrate with which wiring plating cannot be managed from the carrying in part 601 of the semiconductor substrate is transported to the load unload part 617, The robot arm 616-1 receives this semiconductor substrate, it transports to the copper-plating tub 602, and a copper plating layer is formed on the surface of a semiconductor substrate including the wiring section which consists of a wiring gutter or a wiring hole by this plating tub. The semiconductor substrate in which this copper plating layer was formed is transported to the CMP section 605 by the robot arm 616-1, it leaves the copper plating layer formed in the wiring section which consists of a wiring gutter or a wiring hole from a copper plating layer in this CMP section 605, and the excessive copper plating layer on the surface of the semiconductor substrate W is removed.
[0057]After rinsing treatment of the semiconductor substrate from which the copper plating layer with the excessive surface was removed is transported and carried out to the rinse tank 604 by the robot arm 616-1, it is transported to the pretreatment tub 611 and pretreatment before covering plating is performed by this pretreatment tub 611. By the robot arm 616-1, the semiconductor substrate which this pretreatment ended is transported to the covering plating bath 612, it is this covering plating bath 612, and is formed in the wiring section which consists of a wiring gutter or a wiring hole, and forms a protective film on a copper plating layer. The semiconductor substrate in which the protective film was formed is transported to the load unload part 617, after being transported to the dry tub 608 after it is transported to the rinse tank 604 and rinsing treatment is carried out by the robot arm 616-1 here, and drying.The semiconductor substrate which this wiring plating ended is transported to the carrying out portion 609.
[0058]Drawing 12 is a figure showing the plane constitution of other semiconductor substrate processing units. This semiconductor substrate processing unit, The load unload part 701, the copper-plating unit 702, the 1st robot 703, the 3rd soaping machine 704, the reversal machine 705, the reversal machine 706, the 2nd soaping machine 707, the 2nd robot 708, the 1st soaping machine 709, the 1st polishing device 710, and the 2nd polishing device 711. It is the arranged composition. Near the 1st robot 703, the order [plating] thickness measurement machine 712 which measures the thickness before and behind plating, and the dryness thickness measurement machine 713 which is after polish and measures the thickness of the semiconductor substrate W of dryness are arranged.
[0059]The 1st polishing device (grinding unit) 710 possesses the polishing table 710-1, the top ring 710-2, the top ring head 710-3, the thickness measurement machine 710-4, and the pusher 710-5. The 2nd polishing device (grinding unit) 711 possesses the polishing table 711-1, the top ring 711-2, the top ring head 711-3, the thickness measurement machine 711-4, and the pusher 711-5.
[0060]The cassette 701-1 which accommodated the semiconductor substrate W by which the contact hole and the slot for wiring were formed and the seed layer was formed on it is laid in the load port of the load unload part 701. The 1st robot 703 takes out the semiconductor substrate W from the cassette 701-1, carries it in to the copper-plating unit 702, and forms a copper-plating film. The thickness of a seed layer is then measured with the thickness measurement machine 712 before and after plating. Membrane formation of a copper-plating film performs hydrophilic processing of the surface of the semiconductor substrate W first, and forms by performing copper plating after that. The copper-plating unit 702 performs rinse or washing after formation of a copper-plating film. It may dry, as long as time has a margin.
[0061]When the semiconductor substrate W is taken out from the copper-plating unit 702 by the 1st robot 703, the thickness of a copper-plating film is measured with the thickness measurement machine 712 before and after plating. The measurement result is recorded on a

recorder (not shown) as record data of a semiconductor substrate, and, moreover, is used also for the judgment of the abnormalities of the copper-plating unit 702. After thickness measurement, the 1st robot 703 passes the semiconductor substrate W to the reversal machine 705, and makes it reversed with this reversal machine 705 (the field in which the copper-plating film was formed turns down). There are a series mode and a parallel mode in polish by the 1st polishing device 710 and the 2nd polishing device 711. Hereafter, polish of a series mode is explained.

[0062]Series mode polish is polish which performs primary polish with the polishing device 710, and performs secondary polish with the polishing device 711. The semiconductor substrate W on the reversal machine 705 is taken up by the 2nd robot 708, and the semiconductor substrate W is carried on the pusher 710-5 of the polishing device 710. The top ring 710-2 adsorbs this semiconductor substrate W on the pusher 710-5, carries out the contact press of the copper-plating film formation side of the semiconductor substrate W, and performs primary polish to the polished surface of the polishing table 710-1. In this primary polish, a copper-plating film is ground fundamentally. The polished surface of the polishing table 710-1 fixes or impregnated with foaming polyurethane like IC1000, or an abrasive grain, and is constituted. A copper-plating film is ground by the relative motion of this polished surface and the semiconductor substrate W.

[0063]The semiconductor substrate W is returned on the pusher 710-5 by the top ring 710-2 after the grinding completion of a copper-plating film. The 2nd robot 708 takes up this semiconductor substrate W, and puts it into the 1st soaping machine 709. And it may be made hard to attach. [injecting a drug solution at the surface and the rear face of the semiconductor substrate W on the pusher 710-5 at this time, and removing particle]

[0064]In the 1st soaping machine 709, the semiconductor substrate W is taken up by the 2nd robot 708 after the end of washing, and the semiconductor substrate W is carried on the pusher 711-5 of the 2nd polishing device 711. The semiconductor substrate W on the pusher 711-5 is adsorbed by the top ring 711-2, the contact press of the field in which the barrier layer of this semiconductor substrate W was formed is carried out at the polished surface of the polishing table 711-1, and secondary polish is performed. A barrier layer is ground in this secondary polish. However, there is also a case where the copper film which remained by the above-mentioned primary polish, and an oxide film are also ground.

[0065]The polished surface of the polishing table 711-1 fixes or impregnated with foaming polyurethane like IC1000, or an abrasive grain, is constituted, and is ground by the relative motion of this polished surface and the semiconductor substrate W. Silica, alumina, Seria, etc. are used for an abrasive grain or a slurry at this time. A drug solution is adjusted with a membrane type to grind.

[0066]The thickness of a barrier layer is measured using an optical thickness measurement machine, and detection of the terminal point of secondary polish is performed by surface detection of the insulator layer which consists of that thickness was set to 0, or SiO_2. As the thickness measurement machine 711-4 formed near the polishing table 711-1, using a thickness measurement machine with an image processing function, an oxide film is measured and it is judged whether it can leave as processing record of the semiconductor substrate W, or the semiconductor substrate W which secondary polish ended can be transported to the following process. When it regrinds when a secondary polishing end point is not arrived at, or it is ground exceeding default value by a certain abnormalities, a semiconductor substrate processing unit is stopped so that inferior goods may not be increased and the next polish may not be performed.

[0067]Even the pusher 711-5 moves the semiconductor substrate W by the top ring 711-2 after secondary grinding completion. The semiconductor substrate W on the pusher 711-5 is taken up by the 2nd robot 708. It may be made hard to inject a drug solution at the surface and the rear face of the semiconductor substrate W on the pusher 711-5, and to remove particle at this time, or to attach.

[0068]The 2nd robot 708 washes by carrying in the semiconductor substrate W to the 2nd soaping machine 707. The composition of the 2nd soaping machine 707 is also the same composition as the 1st soaping machine 709. Cleaning by scrubbing of the surface of the semiconductor substrate W is mainly carried out to pure water by a PVA sponge roll using the penetrant remover which added the surface-active agent, the chelating agent, and the pH adjuster for particle removal. If the copper which blew off and has diffused strong drug solutions, such as DHF, is etched into the rear face of the semiconductor substrate W from a nozzle or there is no problem of diffusion in it, cleaning by scrubbing by a PVA sponge roll will be carried out using the same drug solution as the surface.
[0069]The semiconductor substrate W is taken up by the 2nd robot 708 after the end of the above-mentioned washing, and it moves to the reversal machine 706, and is made reversed with this reversal machine 706. The reversed this semiconductor substrate W is taken up by the 1st robot 703, and it puts into the 3rd soaping machine 704. In the 3rd soaping machine 704, the megasonic water excited by the surface of the semiconductor substrate W by supersonic vibration is injected and washed. Publicly known pencil type sponge may wash the surface of the semiconductor substrate W using the penetrant remover which added the surface-active agent, the chelating agent, and the pH adjuster to pure water then. Then, the semiconductor substrate W is dried by spin drying. When thickness is measured with the thickness measurement machine 711-4 formed near the polishing table 711-1 as mentioned above, it accommodates in the cassette laid in the unloading port of the load unload part 701 as it is.
[0070]Drawing 13 is a figure showing the plane constitution of other semiconductor substrate processing units. A different point from the semiconductor substrate processing unit shown in drawing 12 of this semiconductor substrate processing unit is a point of having formed the lid plating unit 750 instead of the copper-plating unit 702 shown in drawing 12. The cassette 701-1 which accommodated the semiconductor substrate W in which the copper film was formed is laid in the load unload part 701. The semiconductor substrate W is taken out from the cassette 701-1, it is conveyed by the 1st polishing device 710 or the 2nd polishing device 711, and the surface of a copper film is ground here. The semiconductor substrate W is conveyed and washed by the 1st soaping machine 709 after this grinding completion.
[0071]A copper-plating film is prevented from the semiconductor substrate W washed with the 1st soaping machine 709 being conveyed by the lid plating unit 750, and a protective film being formed in the surface of a copper-plating film here, and oxidizing in the atmosphere by this. By the 2nd robot 708, the semiconductor substrate W which performed lid plating is conveyed by the 2nd soaping machine 707 from the lid plating unit 750, and is washed by pure water or deionized water here. The semiconductor substrate W after this washing is returned to the cassette 701-1 laid in the load unload part 701.
[0072]Drawing 14 is a figure showing the plane constitution of the semiconductor substrate processing unit of further others. A different point from the semiconductor substrate processing unit shown in drawing 13 of this semiconductor substrate processing unit is a point of having formed the annealing unit 751 instead of the 1st soaping machine 709 shown in drawing 13. The semiconductor substrate W which was ground with the 1st polishing device 710 or the 2nd polishing device 711 as mentioned above, and was washed with the 2nd soaping machine 707 is conveyed by the lid plating unit 750, and lid plating is performed to the surface of a copper-plating film here. By the 1st robot 703, from the lid plating unit 750, the semiconductor substrate W to which this lid plating was performed is conveyed by the 3rd soaping machine 704, and is washed here.
[0073]The semiconductor substrate W washed with the 1st soaping machine 709 is conveyed by the annealing unit 751, and is annealed here. A copper-plating film is alloyed by this and the electron migration tolerance of a copper-plating film improves by it. The semiconductor substrate W to which annealing was given is conveyed by the 2nd soaping machine 707 from the annealing

unit 751, and is washed by pure water or deionized water here. The semiconductor substrate W after this washing is returned to the cassette 701-1 laid in the load unload part 701.
[0074]Drawing 15 is a figure showing other plane configuration composition of a substrate processing device. In drawing 15, the portion which attached drawing 12 and identical codes shows a same or considerable portion. This substrate polish device approaches the 1st polishing device 710 and the 2nd polishing device 711, and arranges the pusher indexer 725, The substrate mounting bases 721 and 722 are arranged near the 3rd soaping machine 704 and the copper-plating unit 702, respectively, The robot 723 has been arranged near the 1st soaping machine 709 and the 3rd soaping machine 704, and the robot 724 has been arranged near the 2nd soaping machine 707 and the copper-plating unit 702, and also the dryness thickness measurement machine 713 is arranged near the load unload part 701 and the 1st robot 703.
[0075]In the substrate processing device of the above-mentioned composition, the 1st robot 703, After taking out the semiconductor substrate W from the cassette 701-1 currently laid in the load port of the load unload part 701 and measuring the thickness of a barrier layer and a seed layer with the dryness thickness measurement machine 713, this semiconductor substrate W is put on the substrate mounting base 721. When the dryness thickness measurement machine 713 is formed in the hand of the 1st robot 703, it measures thickness there and puts on the substrate mounting base 721. The semiconductor substrate W on the substrate mounting base 721 is transported to the copper-plating unit 702 by the 2nd robot 723, and a copper-plating film is formed. The thickness of a copper-plating film is measured with the thickness measurement machine 712 before and after plating after membrane formation of a copper-plating film. Then, the semiconductor substrate W is transported to the pusher indexer 725, and the 2nd robot 723 carries it.
[0076][Series mode] In a series mode, the semiconductor substrate W on the pusher indexer 725 is adsorbed, and it transports to the polishing table 710-1, and the top ring head 710-2 presses this semiconductor substrate W to the polished surface on the polishing table 710-1, and grinds to it. Terminal point detection of polish is performed by the same method as the above, and the semiconductor substrate W after grinding completion is transported and carried in the pusher indexer 725 by the top ring head 710-2. The semiconductor substrate W is taken out by the 2nd robot 723, and it carries in, washes and carries [transport and] in the 1st soaping machine 709 in the pusher indexer 725 continuously.
[0077]The semiconductor substrate W on the pusher indexer 725 is adsorbed, and it transports to the polishing table 711-1, and the top ring head 711-2 presses this semiconductor substrate W to the polished surface, and grinds to it. Terminal point detection of polish is performed by the same method as the above, and the semiconductor substrate W after grinding completion is transported and carried in the pusher indexer 725 by the top ring head 711-2. After taking up the semiconductor substrate W and measuring thickness with the thickness measurement machine 726, the 3rd robot 724 is carried in to the 2nd soaping machine 707, and is washed. Then, it carries in to the 3rd soaping machine 704, after washing here, it dries by spin-dry, and the semiconductor substrate W is taken up by the 3rd robot 724 after that, and it carries on the substrate mounting base 722.
[0078][Parallel mode] In a parallel mode, the top ring head 710-2 or 711-2 adsorbs the semiconductor substrate W on the pusher indexer 725, It transports to the polishing table 710-1 or 711-1, and this semiconductor substrate W is pressed to the polished surface on the polishing table 710-1 or 711-1, and it grinds to it, respectively. After measuring thickness, the semiconductor substrate W is taken up by the 3rd robot 724, and it carries on the substrate mounting base 722. After the 1st robot 703 transports the semiconductor substrate W on the substrate mounting base 722 to the dryness thickness measurement machine 713 and measures thickness, it is returned to the cassette 701-1 of the load unload part 701.
[0079]Drawing 16 is a figure showing other plane configuration composition of a substrate

processing device. It is a substrate processing device which forms and grinds a seed layer and a copper-plating film in this substrate processing device to the semiconductor substrate W in which the seed layer is not formed, and forms circuit wiring. This substrate polish device approaches the 1st polishing device 710 and the 2nd polishing device 711, and arranges the pusher indexer 725, The substrate mounting bases 721 and 722 are arranged near the 2nd soaping machine 707 and the seed layer forming unit 727, respectively, The seed layer forming unit 727 and the copper-plating unit 702 were approached, the robot 723 has been arranged, and the robot 724 has been arranged near the 1st soaping machine 709 and the 2nd soaping machine 707, and also the dry membrane thickness measuring apparatus 713 is arranged near the load unload part 701 and the 1st robot 703.

[0080]The semiconductor substrate W in which the barrier layer is formed is taken out from the cassette 701-1 currently laid in the load port of the load unload part 701 by the 1st robot 703, and it puts on the substrate mounting base 721. Next, the 2nd robot 723 conveys the semiconductor substrate W to the seed layer forming unit 727, and forms a seed layer. Nonelectrolytic plating performs membrane formation of this seed layer. The 2nd robot 723 measures the thickness of a seed layer for the semiconductor substrate in which the seed layer was formed with the thickness measurement machine 712 before and after plating. It carries in to the copper-plating unit 702 after thickness measurement, and a copper-plating film is formed.

[0081]The thickness is measured after forming a copper-plating film, and it transports to the pusher indexer 725. The top ring 710-2 or 711-2 adsorbs the semiconductor substrate W on the pusher indexer 725, is transported to the polishing table 710-1 or 711-1, and is ground. After polish, the top ring 710-2 or 711-2 transports the semiconductor substrate W to the thickness measurement machine 710-4 or 711-4, measures thickness, and transports and puts it on the pusher indexer 725.

[0082]Next, the 3rd robot 724 takes up the semiconductor substrate W from the pusher indexer 725, and carries it in to the 1st soaping machine 709. The semiconductor substrate which the 3rd robot 724 took up the semiconductor substrate W washed from the 1st soaping machine 709, carried it in to the 2nd soaping machine 707, was washed, and was dried is laid on the substrate mounting base 722. Next, the 1st robot 703 takes up the semiconductor substrate W, measures thickness with the dryness thickness measurement machine 713, and stores it to the cassette 701-1 currently laid in the unloading port of the load unload part 701.

[0083]Also in the substrate processing device shown in drawing 16, on the semiconductor substrate W in which the contact hole or slot on the circuit pattern was formed, a barrier layer, a seed layer, and a copper-plating film can be formed and ground, and circuit wiring can be formed. The cassette 701-1 which accommodated the semiconductor substrate W before barrier layer formation is laid in the load port of the load unload part 701. And from the cassette 701-1 currently laid in the load port of the load unload part 701 by the 1st robot 703, the semiconductor substrate W is taken out and it puts on the substrate mounting base 721. Next, the 2nd robot 723 conveys the semiconductor substrate W to the seed layer forming unit 727, and forms a barrier layer and a seed layer. Nonelectrolytic plating performs membrane formation of this barrier layer and a seed layer. The 2nd robot 723 measures the thickness of the barrier layer formed in the semiconductor substrate W with the thickness measurement machine 712 before and after plating, and a seed layer. It carries in to the copper-plating unit 702 after thickness measurement, and a copper-plating film is formed.

[0084]Drawing 17 is a figure showing other plane configuration composition of a substrate processing device. This substrate processing device, The barrier layer forming unit 811, the seed layer forming unit 812, the plating unit 813, the annealing unit 814, the 1st washing unit 815, a bevel and a rear-face washing unit 816, the lid plating unit 817, the 2nd washing unit 818, the 1st aligner and film thickness gage 841, The 2nd aligner and film thickness gage 842, the 1st substrate reversal machine 843, the 2nd substrate reversal machine 844, the substrate

temporary placing stand 845, the 3rd film thickness gage 846, the load unload part 820, the 1st polishing device 821, the 2nd polishing device 822, the 1st robot 831, the 2nd robot 832, It is the composition which has arranged the 3rd robot 833 and the 4th robot 834. The film thickness gage 841,842,846 is a unit, and since the same size as the frontage size of other units (units, such as plating, washing, and annealing) is chosen, it can be replaced freely. In this example, a non-electrolytic copper plating device can be used for unelectrolyzed Ru plating device and the seed layer forming unit 812, and, as for the plating unit 813, an electrolysis plating device can be used for the barrier layer forming unit 811.

[0085]Drawing 18 is a flow chart which shows the flow of each process within this substrate processing device. Each process within this device is explained according to this flow chart. First, the semiconductor substrate taken out from the cassette 820a laid in the load unloading unit 820 by the 1st robot 831 turns a field to be plated up into the 1st aligner and thickness measurement unit 841, and is arranged. Here, in order to define the reference point of the position which performs thickness measurement, after performing notch alignment for thickness measurement, the thickness data of the semiconductor substrate before copper film formation is obtained.

[0086]Next, a semiconductor substrate is conveyed by the 1st robot 831 to the barrier layer forming unit 811. This barrier layer forming unit 811 is a device which forms a barrier layer on a semiconductor substrate with unelectrolyzed Ru plating, and forms Ru as a copper diffusion preventing film to the interlayer insulation film (for example, SiO_2) of a semiconductor device. The semiconductor substrate paid out through washing and a drying process is conveyed by the 1st aligner and thickness measurement unit 841 with the 1st robot 831, and has the thickness of a semiconductor substrate, i.e., the thickness of a barrier layer, measured.

[0087]The semiconductor substrate by which thickness measurement was carried out is carried in to the seed layer forming unit 812 by the 2nd robot 832, and a seed layer is formed by non-electrolytic copper plating on said barrier layer. Before the semiconductor substrate paid out through washing and a drying process is conveyed with the 2nd robot 832 by the plating unit 813 which is an impregnating plating unit, in order to define a notch position, it is conveyed by the 2nd aligner and film thickness gage 842, and aligns the notch for copper plating. Here, the thickness of the semiconductor substrate before copper film formation may be re-measured if needed.

[0088]The semiconductor substrate which notch alignment completed is conveyed by the 3rd robot 833 to the plating unit 813, and copper plating is given. The semiconductor substrate paid out through washing and a drying process is conveyed to a bevel and the rear-face washing unit 816, in order for the 3rd robot 833 to remove the copper film (seed layer) which does not need a semiconductor substrate end. In a bevel and the rear-face washing unit 816, while etching a bevel in time set up beforehand, drug solutions, such as fluoric acid, wash copper adhering to a semiconductor substrate rear face. Before conveying to a bevel and the rear-face washing unit 816 at this time, thickness measurement of a semiconductor substrate is carried out with the 2nd aligner and film thickness gage 842, the value of the copper film thickness formed by plating is obtained, and it may etch by changing the etching time of a bevel arbitrarily by that result. The field etched by bevel etching is an edge part of a substrate, and is a field which is not eventually used as a chip even if the field in which a circuit is not formed, or the circuit is formed. A bevel portion is contained in this field.

[0089]The semiconductor substrate paid out through washing and a drying process with the bevel and the rear-face washing unit 816, After being conveyed by the substrate reversal machine 843 by the 3rd robot 833, being reversed with this substrate reversal machine 843 and turning a field to be plated caudad, in order to stabilize a wiring section with the 4th robot 834, it is supplied to the annealing unit 814. The thickness of a copper film which carried in to the 2nd aligner and thickness measurement unit 842 before annealing treatment and/or after processing, and was formed in the semiconductor substrate is measured. Then, a semiconductor substrate is

carried in to the 1st polishing device 821 by the 4th robot 834, and performs polish of the copper layer of a semiconductor substrate, and a seed layer.
[0090]Under the present circumstances, bonded abrasive can also be used, in order that abrasive grains may prevent dishing and may take out surface flatness, although a desired thing is used. After the end of the 1st polishing, a semiconductor substrate is conveyed by the 1st washing unit 815 with the 4th robot 834, and is washed. It is cleaning by scrubbing washed while passing pure water or deionized water, this washing arranging the roll which has the almost same length as a semiconductor substrate diameter at the surface and the rear face of a semiconductor substrate, and rotating a semiconductor substrate and a roll.
[0091]A semiconductor substrate is carried in to the 2nd polishing device 822 by the 4th robot 834 after the 1st end of washing, and the barrier layer on a semiconductor substrate is ground. Under the present circumstances, bonded abrasive can also be used, in order that abrasive grains may prevent dishing and may take out surface flatness, although a desired thing is used. Cleaning by scrubbing of the semiconductor substrate is again conveyed and carried out to the 1st washing unit 815 by the 4th robot 834 after the end of the 2nd polishing. After the end of washing, it is conveyed by the 2nd substrate reversal machine 844 with the 4th robot 834, it is reversed, and the semiconductor substrate can turn a field to be plated up, and also is put on the substrate temporary placing stand 845 by the 3rd robot 833.
[0092]A semiconductor substrate is conveyed by the lid plating unit 817 from the substrate temporary placing stand 845 with the 2nd robot 832, and performs nickel boron plating on a copper surface for the purpose of antioxidizing by the copper atmosphere. The semiconductor substrate to which lid plating was performed is carried in to the 3rd film thickness gage 846 from the lid plating unit 817 by the 2nd robot 832, and copper film thickness is measured. Then, a semiconductor substrate is carried in to the 2nd washing unit 818 by the 1st robot 831, and is washed by pure water or deionized water. The semiconductor substrate which washing ended is returned in the cassette 820a laid in the load unload part 820 by the stand 1 robot 831. The aligner and film thickness gage 841 and the aligner and film thickness gage 842 perform positioning of a substrate notch portion, and measurement of thickness.
[0093]Edge (bevel) copper etching and rear-face washing can be performed simultaneously, and a bevel and the rear-face washing unit 816 can suppress growth of the natural oxidation film of copper of the circuit formation part of a substrate face. The schematic diagram of a bevel and the rear-face washing unit 816 is shown in drawing 19. As shown in drawing 19, a bevel and the rear-face washing unit 816 are provided with the following.
The substrate attaching part 922 which holds the substrate W horizontally by the spin chuck 921 and to which it is located in the inside of the raintight cover 920 of closed-end cylindrical shape, and a high velocity revolution is carried out at two or more places which met the circumferencial direction of the edge part by face up.
The center nozzle 924 by the side of the surface of the substrate W held by this substrate attaching part 922 arranged mostly in the center-section upper part.
The edge nozzle 926 arranged above the edge part of the substrate W.
The center nozzle 924 and the edge nozzle 926 are arranged downward, respectively. the rear-face side of the substrate W -- it is mostly located down the center section and the back nozzle 928 is arranged upward. Said edge nozzle 926 is constituted in the diametral direction and height direction of the substrate W, enabling free movement.
[0094]Positioning arbitrary from the peripheral end face of a substrate to the direction of the central part is attained, and the moving width L of this edge nozzle 926 inputs a preset value according to a size, the purpose, etc. of using the substrate W. Usually, edge cut width C is set up in 2 to 5 mm, and if it is more than the number of rotations from which the amount of surroundings lumps of the liquid from a rear face to the surface does not become a problem, the copper film in the set-up cut width C is removable.

[0095]Next, the cleaning method by this washing station is explained. First, one is made to carry out horizontal rotation of the semiconductor substrate W to the substrate attaching part 922, where a substrate is horizontally held by the substrate attaching part 922 via the spin chuck 921. In this state, an acid solution is supplied to the center section by the side of the surface of the substrate W from the center nozzle 924. As this acid solution, what is necessary is just acid of a non-oxidizing quality, and fluoric acid, chloride, sulfuric acid, citrate, oxalic acid, etc. are used. On the other hand, an oxidizer solution is supplied to the edge part of the substrate W continuously or intermittently from the edge nozzle 926. Those combination is used, using sodium hypochlorite ozone water, hydrogen peroxide solution, nitric acid water, or water etc. as this oxidizer solution.

[0096]Thereby, in the field of edge cut width C of the edge part of the semiconductor substrate W, the copper film formed in the upper surface and the end face oxidizes quickly with an oxidizer solution, and dissolution removal is etched and carried out with the acid solution which is simultaneously supplied from the center nozzle 924 and spreads in the entire surface of a substrate. Thus, compared with supplying those mixed water from a nozzle beforehand, a steep etching profile can be obtained by mixing an acid solution and an oxidizer solution in a substrate edge part. A copper etching rate is determined by the concentration of them at this time.When the copper natural oxidation film is formed in the circuit formation part of the surface of a substrate, with the acid solution which spreads covering the entire surface of a substrate with rotation of a substrate, this natural oxidation thing is removed promptly and does not grow. After suspending supply of the acid solution from the center nozzle 924, by suspending supply of the oxidizer solution from the edge nozzle 926, the silicon exposed to the surface can be oxidized and adhesion of copper can be controlled.

[0097]On the other hand, an oxidizer solution and a silicon oxide etching agent are supplied to the rear-face center section of the substrate simultaneous or by turns from the back nozzle 928. It can oxidize with an oxidizer solution the whole silicon of a substrate, and the copper etc. which have adhered to the rear-face side of the semiconductor substrate W in metallic shapes by this can be etched and removed by a silicon oxide etching agent. It is desirable when the direction made into the same thing as the oxidizer solution supplied to the surface as this oxidizer solution lessens the kind of medicine. The kind of medicine can be lessened, if fluoric acid can be used and the acid solution by the side of the surface of a substrate also uses fluoric acid as a silicon oxide etching agent. By this, if oxidizer supply is suspended previously, a canal side will be acquired, if an etching agent solution is suspended previously, a saturation side (hydrophilic side) will be acquired, and it can also adjust to the rear face according to a demand of a subsequent process.

[0098]Thus, an acid solution, i.e., an etching reagent, is supplied to a substrate, after removing the metal ion which remains on the surface of the substrate W, pure water is supplied, pure water substitution is performed, an etching reagent is removed, and spin drying is performed after that. Thus, removal of the copper film in edge cut width C of the edge part of a semiconductor substrate surface and copper contamination removal on the back can be performed simultaneously, and, for example, this processing can be made to complete within 80 seconds. Although it is possible to set the edge cut width of edge as arbitration (2 mm - 5 mm), it does not depend on cut width for the time which etching takes.

[0099]Before the CMP process after plating, performing annealing treatment shows a good effect to next CMP treatment or the electrical property of wiring. When the surface of wide wiring (several micrometer unit) was observed without annealing after CMP treatment, many defects like a micro void were seen, and the electrical resistance of the whole wiring was made to increase, but the increase in this electrical resistance has improved by performing annealing. When you have no annealing, to thin wiring, it is possible from a void not having been seen that the degree of grain growth is concerned. That is, in process of the grain growth accompanying [although grain growth does not happen easily in thin wiring] annealing treatment in connection

with grain growth by wide wiring, The guess that the dent for micro voids arose in the wiring upper part by moving upwards can be performed detailed pore overly concentrating in like [SEM (scanning electron microscope) in a plating film is not visible, either]. As for addition (2% or less) and temperature, as for the atmosphere of gas, as an annealing condition of an annealing unit, the above-mentioned effect was acquired in 1 to 5 minutes at about 300-400 ** in hydrogen.
[0100]Drawing 22 and drawing 23 show the annealing unit 814. This annealing unit 814 is located in the inside of the chamber 1002 which has the gate 1000 take the semiconductor substrate W in and out of which, The hot plate 1004 which heats the semiconductor substrate W, for example at 400 **, and the cool plates 1006 which pour cooling water, for example and cool the semiconductor substrate W are arranged up and down. The inside of the cool plates 1006 is penetrated, it extends in a sliding direction, and two or more rise-and-fall pins 1008 which carry out installation maintenance of the semiconductor substrate W are arranged at the upper bed, enabling free rise and fall. The gas introducing pipe 1010 which introduces the gas for antioxidizing between the semiconductor substrate W and the hot plate 1008 at the time of annealing, It is introduced from this gas introducing pipe 1010, and is arranged at the position against which the gas exhaust pipes 1012 which exhaust the gas which flowed between the semiconductor substrate W and the hot plate 1004 stand face to face mutually on both sides of the hot plate 1004.
[0101]N_2 gas by which the gas introducing pipe 1010 flows into an inside through the inside of N_2 gas introducing path 1016 which has the filter 1014a, It is connected to the mixed gas introducing path 1022 through which the gas which mixed H_2 gas which flows into an inside through the inside of H_2 gas introducing path 1018 which has the filter 1014b with the mixer 1020, and was mixed with this mixer 1020 flows.
[0102]This holds the semiconductor substrate W carried in to the inside of the chamber 1002 through the gate 1000 by the rise-and-fall pin 1008, The distance of the semiconductor substrate W and the hot plate 1004 which held the rise-and-fall pin 1008 by this rise-and-fall pin 1008 makes it go up until it is set to about 0.1-1.0 mm, for example. In this state, via the hot plate 1004, the semiconductor substrate W is heated so that it may become 400 **, for example, the gas for antioxidizing is simultaneously introduced from the gas introducing pipe 1010, between the semiconductor substrate W and the hot plates 1004 is passed, and it exhausts from the gas exhaust pipes 1012. By this, the semiconductor substrate W is annealed preventing oxidation, this annealing is continued tens of seconds - about 60 seconds, for example, and annealing is ended. As for the cooking temperature of a substrate, 100-600 ** is chosen.
[0103]The distance of the semiconductor substrate W and the cool plates 1006 which held the rise-and-fall pin 1008 by this rise-and-fall pin 1008 makes it descend after the end of annealing until it is set to about 0-0.5 mm, for example. In this state, by introducing cooling water in the cool plates 1006, a semiconductor substrate is cooled about 10 to 60 seconds, for example, and the semiconductor substrate after this end of cooling is conveyed to a next process until the temperature of the semiconductor substrate W will be 100 ** or less. Although he is trying to pass the mixed gas which mixed N_2 gas and H_2 gas of several percent as gas for antioxidizing in this example, it may be made to pass only N_2 gas.
[0104]Drawing 20 is an outline lineblock diagram of electroless plating equipment. As shown in drawing 20, this electroless plating equipment, The holding mechanism 911 which holds the semiconductor substrate W which is a member to be plated on the upper surface, It has the showerhead 941 which supplies plating liquid to the field of the semiconductor substrate W by which the seal was carried out in the edge part by the weir member 931 which carries out the seal of this edge part in contact with the edge part of the field (upper surface) of the semiconductor substrate W held at the holding mechanism 911 to be plated, and the weir member

931 to be plated. Electroless plating equipment is provided with the following.
The cleaning liquid supplying means 951 which is furthermore installed near the upper part periphery of the holding mechanism 911, and supplies a penetrant remover to the field of the semiconductor substrate W to be plated.
The recovery container 961 which collects the penetrant removers (plating waste fluid) etc. which were discharged.
The plating liquid recovery nozzle 965 which attracts and collects the plating liquid held on the semiconductor substrate W.
The motor M which rotates said holding mechanism 911.
Hereafter, each member is explained.
[0105]The holding mechanism 911 has formed the board mounting part 913 which lays and holds the semiconductor substrate W on the upper surface. This board mounting part 913 is constituted so that the semiconductor substrate W may be laid and it may fix, and it is installing the vacuum absorption mechanism which specifically carries out vacuum absorption of the semiconductor substrate W to that rear-face side and which is not illustrated. On the other hand, the back heater 915 which is surface state, heats the field of the semiconductor substrate W to be plated from the undersurface side, and keeps it warm is installed in the rear-face side of the board mounting part 913. This back heater 915 is constituted by the rubber heater, for example. It rotates by the motor M, and this holding mechanism 911 is constituted so that it can move up and down by the ascending and descending means which is not illustrated. The weir member 931 forms the seal part 933 which is cylindrical and carries out the seal of the periphery edge of the semiconductor substrate W to the lower part, and it is installed so that it may not move up and down from the position of a graphic display.
[0106]The showerhead 941 is providing many nozzles at a tip, and is a thing of the structure which distributes the supplied plating liquid in the shape of a shower, and is supplied to the field of the semiconductor substrate W to be plated at abbreviated homogeneity. The cleaning liquid supplying means 951 is a structure which spouts a penetrant remover from the nozzle 953. The plating liquid recovery nozzle 965 is constituted so that it can move up and down and circle, and it is constituted so that the tip may descend inside the weir member 931 of the upper surface edge part of the semiconductor substrate W and may attract the plating liquid on the semiconductor substrate W.
[0107]Next, operation of this electroless plating equipment is explained. The holding mechanism 911 is first descended rather than the state of a graphic display, the crevice between prescribed dimensions is established between the weir members 931, and the semiconductor substrate W is laid and fixed at the board mounting part 913. As the semiconductor substrate W, for example, phi 8-inch board is used. Next, go up the holding mechanism 911, the upper surface is made to contact the undersurface of the weir member 931 like a graphic display, and the seal of the periphery of the semiconductor substrate W is simultaneously carried out by the seal part 933 of the weir member 931. The surface of the semiconductor substrate W is in the state where it was opened wide, at this time.
[0108]Next, direct heating of the semiconductor substrate W itself shall be carried out with the back heater 915, the temperature of the semiconductor substrate W shall be 70 ** (it maintains till the end of plating), next the plating liquid heated by 50 **, for example is blown off from the showerhead 941, and plating liquid is poured on abbreviated [of the surface of the semiconductor substrate W / whole]. Since the surface of the semiconductor substrate W is surrounded by the weir member 931, all the poured-in plating liquid is held on the surface of the semiconductor substrate W. A small quantity of the grade which serves as 1-mm thickness (about 30 ml) on the surface of the semiconductor substrate W may be sufficient as the quantity of the plating liquid to supply. The depth of the plating liquid held on a field to be plated is just 10 mm or less, and 1 mm of it may be sufficient like this example. If the plating liquid supplied like

this example can be managed with a small quantity, the heating apparatus which heats this will also be small and will become good. And in this example, since the temperature of the semiconductor substrate W is heated at 70 ** and the temperature of plating liquid is heated at 50 **, the field of the semiconductor substrate W to be plated will be 60 **, and is made to the optimal temperature for the plating reaction in this example. Thus, since it is not necessary to carry out temperature up of the temperature of the required plating liquid of big power consumption to heating so highly if it constitutes so that the semiconductor substrate W itself may be heated, prevention of the reduction of power consumption and construction material change of plating liquid can be aimed at, and it is suitable. The power consumption for heating of the semiconductor substrate W itself may be small, and since there is little quantity of the plating liquid collected on the semiconductor substrate W, incubation of the semiconductor substrate W by the back heater 915 can be performed easily, the capacity of the back heater 915 may be small, and miniaturization of a device can be attained. If a means to cool the semiconductor substrate W itself directly is used, it is also possible to change heating and cooling during plating and to change plating conditions. Since the plating liquid currently held on the semiconductor substrate is little, temperature control can be performed with sufficient sensitivity.
[0109]And instant rotation of the semiconductor substrate W is carried out by the motor M, uniform ****** of a field to be plated is performed, and a field to be plated is plated with the state where the conductor substrate W was stood still the second half. Specifically rotate the semiconductor substrate W at 100 rpm or less only 1 sec, soak the field [to be plated] top of the semiconductor substrate W in plating liquid uniformly, it is made to stand it still after that, and the nonelectrolytic plating between 1min is made to perform. Even if instant turnover time is long, it is set to 10 or less sec.
[0110]After the above-mentioned plating processing is completed, the tip of the plating liquid recovery nozzle 965 is descended to the inner neighborhood of the weir member 931 of the surface edge part of the semiconductor substrate W, and plating liquid is sucked in. If the semiconductor substrate W is rotated with the revolving speed of 100 rpm or less at this time, the plating liquid which remained on the semiconductor substrate W can be brought together in the portion of the weir member 931 of the edge part of the semiconductor substrate W with a centrifugal force, and recovery of plating liquid can be efficiently performed in a high recovery rate. And drop the holding mechanism 911 and the semiconductor substrate W is separated from the weir member 931, A nonelectrolytic plating reaction is stopped by dilution and washing at the same time it starts rotation of the semiconductor substrate W, it injects a penetrant remover (ultrapure water) from the nozzle 953 of the cleaning liquid supplying means 951 to the field of the semiconductor substrate W to be plated and it cools a field to be plated. The weir member 931 may be simultaneously washed by applying the penetrant remover injected from the nozzle 953 at this time also to the weir member 931. The plating waste fluid at this time is collected and discarded by the recovery container 961.
[0111]The plating liquid used once is not reused but is considered as throwing away. Since quantity of the plating liquid used in this device as mentioned above is made very small compared with the former, there is little quantity of the plating liquid discarded even if it does not reuse. The plating liquid after use may also be collected to the recovery container 961 as plating waste fluid with a penetrant remover without installing the plating liquid recovery nozzle 965 depending on the case. And after carrying out the high velocity revolution of the semiconductor substrate W and carrying out spin drying by the motor M, it takes out from the holding mechanism 911.
[0112]Drawing 21 is an outline lineblock diagram of other electroless plating equipment. In drawing 21, the point which is different from the aforementioned example is a point which installed the lamp heater (heating method) 917 above the holding mechanism 911, and unified this lamp heater 917 and showerhead 941-2 instead of forming the back heater 915 in the holding mechanism 911. That is, the lamp heater 917 of ring shape with which two or more radii differer,

for example is installed in concentric circle shape, and the opening of many nozzles 943-2 of the showerhead 941-2 is carried out to ring shape from the crevice between the lamp heaters 917. As the lamp heater 917, it may constitute from one spiral lamp heater, and may constitute from a lamp heater of various, still more nearly other structure and arrangement.

[0113]Even if constituted in this way, plating liquid can be supplied uniformly [abbreviation with the shape of a shower] on the field of the semiconductor substrate W to be plated from each nozzle 943-2, and heating and incubation of the semiconductor substrate W can also carry it out to homogeneity directly with the lamp heater 917. In the case of the lamp heater 917, since the air of the circumference is also heated besides the semiconductor substrate W and plating liquid, there is also a heat insulation effect of the semiconductor substrate W.

[0114]In order to carry out direct heating of the semiconductor substrate W with the lamp heater 917, Since the lamp heater 917 of comparatively large power consumption is needed instead, the back heater 915 shown in the lamp heater 917 and said drawing 20 of comparatively small power consumption is used together, The semiconductor substrate W is heated mainly with the back heater 915, and incubation of the air of plating liquid and the circumference may mainly be made to perform it with the lamp heater 917. A means to cool the semiconductor substrate W directly or indirectly as well as the above-mentioned example may be formed, and temperature control may be performed.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]It is a schematic diagram showing the plating device used when it found out that an electric field is formed as if the surface of this film was an anode, when the film had been arranged between the negative pole (cathode) in a plating tub, and the anode (anode).
[Drawing 2]It is a graph which shows the result of having measured the thickness distribution of the plating film formed using the plating device shown in drawing 1.
[Drawing 3]It is a graph which shows the result of having measured the thickness distribution of the plating film formed except for the film from the plating device shown in drawing 1.
[Drawing 4]It is a sectional view showing the outline of the plating device of an embodiment of the invention.
[Drawing 5]It is a plane configuration figure showing a substrate processing device.
[Drawing 6]It is a figure showing the flow of the air current in the substrate processing device shown in drawing 5.
[Drawing 7]It is a figure showing the flow of the air between each area of the substrate processing device shown in drawing 5.
[Drawing 8]It is an outline view showing an example which has arranged the substrate processing device shown in drawing 5 in a clean room.
[Drawing 9]It is a plane configuration figure showing other examples of a substrate processing device.
[Drawing 10]It is a plane configuration figure showing the example of further others of a substrate processing device.
[Drawing 11]It is a plane configuration figure showing the example of further others of a substrate processing device.
[Drawing 12]It is a plane configuration figure showing the example of further others of a substrate processing device.
[Drawing 13]It is a plane configuration figure showing the example of further others of a substrate processing device.
[Drawing 14]It is a plane configuration figure showing the example of further others of a substrate processing device.
[Drawing 15]It is a plane configuration figure showing the example of further others of a substrate processing device.
[Drawing 16]It is a plane configuration figure showing the example of further others of a substrate processing device.
[Drawing 17]It is a plane configuration figure showing the example of further others of a substrate processing device.
[Drawing 18]It is a flow chart which shows the flow of each process in the substrate treating apparatus shown in drawing 17.

[Drawing 19]It is a schematic diagram showing a bevel and a rear-face washing unit.
[Drawing 20]It is a schematic diagram showing an example of electroless plating equipment.
[Drawing 21]It is a schematic diagram showing other examples of electroless plating equipment.
[Drawing 22]It is a vertical section front view showing an example of an annealing unit.
[Drawing 23]It is a flat section of drawing 22.
[Drawing 24]It is a figure showing the example which forms copper interconnect by copper plating at process order.

[Description of Notations]
10 Plating tub
12 Side plate
14 Plating room
14a Substrate side field
14b Anode side field
16 Anode
18 Cation exchange membrane
30, 38 plating fluid tank
32 and 40 Pump
50 Plating tub
52 Substrate holder
54 Anode
56 Plating room
56a Substrate side field
56b Anode side field
58 Peripheral wall
60 Plating liquid spray nozzle
62 Plating liquid supply route
64 Plating liquid exhaust passage
66, 66 plating liquid exhaust passage
68 Current plate
70 Punch plates
72 Housing
74 Press ring
76 Motor
78 Cylinder
82 Substrate attaching part
84 Sealant
86 The point of contact for cathode terminals

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the plating device which performs metal plating, such as copper plating, to the surface (field to be plated) of substrates, such as a semiconductor wafer.
[0002]
[Description of the Prior Art]In recent years, as a metallic material for forming a wiring circuit on a semiconductor substrate, it replaces with aluminum or an aluminum alloy, and the motion using copper (Cu) with high electromigration resistance with low electrical resistivity is remarkable. This kind of copper interconnect with techniques, such as CVD, sputtering, and plating. Generally it is formed of what is called a damascene process that embeds copper to the inside of the detailed dent of a substrate which formed copper on all the surfaces and was mostly provided in them on the surface of the substrate, and removes surplus copper by chemical machinery polish (CMP).
[0003]Drawing 24 (a) - (c) is what shows the example of manufacture of this kind of copper interconnect board W to process order, As shown in drawing 24 (a), the insulating layer 2 which consists of a SiO_2 oxide film, other Low-k material, etc. is deposited on the conductive layer 1a on the semiconductor base material 1 in which the semiconductor device was formed, The seed layer 7 is formed as a feeding layer of electrolysis plating the barrier layer 5 which forms the contact hole 3 and the slot 4 for wiring in the inside of this insulating layer 2, for example with lithography etching technology, and becomes it from TaN etc. on it, and also on it. As the barrier layer 5, a Ta/TaN mixed layer, TiN, WN, SiTiN, CoWP, CoWB, etc. are considered.
[0004]And as shown in drawing 24 (b), while filling up copper with giving copper plating to the surface of the substrate W in the contact hole 3 of the substrate W, and the slot 4 for wiring, the copper film 6 is deposited on the insulating layer 2. Then, by chemical machinery polish (CMP), the copper film 6 on the insulating layer 2 is removed, and the surface of the copper film 6 and the surface of the insulating layer 2 with which the contact hole 3 and the slot 4 for wiring were made to fill up are mostly made into the same flat surface. This forms the wiring which consists of the copper film 6, as shown in drawing 24 (c).
[0005]Here, in, for example, forming a copper layer on the surface of a substrate with electrolytic copper plating which uses a copper sulfate bath as a plating bath, generally, the soluble thing of the phosphorus-containing copper etc. which made copper contain Lynn is used as an anode. When this uses the thing of insolubility as an anode, supply of a copper ion is newly needed, The additive agent in plating liquid carries out oxidative degradation, and exhaust unusually automation of this supply is not only difficult, but, or, It is because the inside of the copper layer embedded to the inside of the detailed slot for wiring formed in the surface and this surface of a substrate by the oxygen to generate or a contact hole has a problem that a plating

defect occurs.
[0006]
[Problem(s) to be Solved by the Invention]However, if electroplating is performed as an anode using soluble anodes, such as phosphorus-containing copper, The distance between electrodes (distance with the field of the substrate used as an anode and a cathode to be plated) will be changed because an anode dissolves with advance of plating, and the homogeneity within a field of the thickness of the plating film formed on the surface of a substrate will change temporally. The black film generated on the surface of an anode is omitted, the inside of plating liquid is floated, and there is also a problem of adhering as particle on the surface of a substrate. When the size of a semiconductor wafer becomes large, the diameter was also 300 mm and the flow of the plating liquid of a between is considered very much, it becomes difficult [it / to make the distance between electrodes small].
[0007]In view of the above, succeeded in this invention, and it uses a soluble anode as an anode, And the homogeneity within a field of the plating film formed in the field (surface) of a substrate to be plated aims at providing the plating device kept from changing temporally with the dissolution of the anode by advance of plating.
[0008]
[Means for Solving the Problem]A substrate holder which the invention according to claim 1 is arranged above a plating tub holding plating liquid, and said plating tub, places a field to be plated upside down, and holds a substrate enabling free attachment and detachment, A plating liquid spray nozzle which injects plating liquid horizontally towards a center from a periphery of said plating tub, It is a plating device having a current plate which is arranged down the flat surface which a plating liquid spray nozzle makes in the upper part of a soluble anode which made plating liquid immerse in said plating tub, and has been arranged, and said anode, and rectifies a flow of plating liquid.
[0009]By this, even if the actual distance between electrodes (distance with a field used as an anode and a cathode to be plated) changes gradually with the dissolution of an anode by advance of plating (it becomes large), The homogeneity within a field of a plating film is prevented from the surface of a current plate located between a substrate and an anode working as the temporary anode (false anode), and the distance between electrodes (distance with a field used as a current plate and a cathode to be plated) on appearance becoming always fixed for this reason, and changing temporally.
[0010]If a porous ion-exchange membrane used for polypropylene membrane used, for example for a filter material etc. or ionic exchange is arranged between the negative pole (cathode) in a plating tub, and the anode (anode), this, the surface of the film is an anode — that — it needs — it is based on having found out that an electric field was formed. A result of having measured thickness distribution of a copper-plating film which formed by performing copper plating on the surface of a substrate (semiconductor wafer) using a plating device with which drawing 2 and drawing 3 show this drawing 1 a plating device which uses drawing 1 then is shown, respectively.

[0011]That is, as shown in drawing 1, this plating device is made to plate on the surface of a substrate (field to be plated) in ** about the substrate W, the plating tub 10 and the side plate 12 are provided, and the plating room 14 in which plating liquid is accommodated is formed in the plating tub 10. A lower end of the side plate 12 is connected with the lower part of the plating tub 10 via a hinge mechanism (not shown), and can open and close now an opening of the plating room 14 of the plating tub 10. The anode 16 of insolubility is formed in the side plate 12 of the plating tub 10, and a field of an opposite hand, and a field by the side of the plating tub 10 of the side plate 12 is equipped with the substrate W which plates a semiconductor wafer etc.
[0012]Where the side plate 12 is closed, the cation exchange membrane 18 is formed in an inside of the plating room 14 of the plating tub 10 so that it may be located between the substrate W

and the anode 16, namely, so that the plating room 14 may be classified into the substrate side field 14a and the anode side field 14b (isolation). The upper header 20 and the lower header 22 are formed in the upper and lower sides of the plating tub 10, and the opening 20a of the upper header 20 and the opening 22a of the lower header 22 are open for free passage to the substrate side field 14a. The plating liquid inlet 24 and the plating liquid port 26 which are open for free passage, respectively are established in the lower part and the upper part of the anode side field 14b at the plating tub 10.

[0013]And it extends from the 1st plating fluid tank 30, the 1st plating liquid introducing pipe 34 which infixed the 1st pump 32 in an inside is connected to the plating liquid inlet 24, and the 1st plating liquid exhaust pipe 36 prolonged from the 1st plating fluid tank 30 is connected to the plating liquid port 26. On the other hand, it extends from the 2nd plating fluid tank 38, the 2nd plating liquid introducing pipe 42 which infixed the 2nd pump 40 in an inside is connected to the lower header 22, and the 2nd plating liquid exhaust pipe 44 prolonged from the 2nd plating fluid tank 38 is connected to the upper header 20. With a drive of the 1st pump 32, plating liquid in the 1st plating fluid tank 30 is introduced in the anode side field 14b of the plating room 14 by this, and circulates by it, With a drive of the 2nd pump 40, plating liquid in the 2nd plating fluid tank 38 is introduced into the substrate side field 14a of the plating room 14, and circulates.

[0014]The side plate 12 is equipped with the substrate (semiconductor wafer) W with a diameter [in which the seed layer 7 (refer to drawing 24 (a)) was formed on the surface] of 200 mm in the above plating devices, It plated by introducing plating liquid into an inside of the plating room 14, impressing plating voltage between the seed layer 7 of this substrate W, and the anode 16. So that a direction of plating fluid pressure power in the anode side field 14b divided by the cation exchange membrane 18 of the plating room 14 may become higher than plating fluid pressure power in the substrate side field 14a at this time, Pump pressure P_1 of the 1st pump 32 was set up more highly ($P_1>P_2$) than pump pressure P_2 of the 2nd pump 40. Thus, a result of having measured thickness distribution of a formed plating film is shown in drawing 2. It turns out that thickness of a plating film is thick in the center section of the substrate W so that clearly from this drawing 2.

[0015]Next, in a device shown in drawing 1, it plated, where the cation exchange membrane 18 is deleted, and thickness distribution of a plating film formed with this plating was measured. A result at this time is shown in drawing 3. It turns out that thickness of a plating film is thick by a peripheral part of a substrate so that clearly from this drawing 3.

[0016]Thus, that data shown in drawing 2 was obtained although the actual distance between electrodes (distance of the seed layer 7 and the anode 16) had not changed, It is because the cation exchange membrane 18 curved toward the direction of the substrate W according to a pressure differential of the fields 14a and 14b of both sides which sandwiched this cation exchange membrane 18 and a center portion of the cation exchange membrane 18 approached the substrate W. It is a plating device shown in drawing 1, and if pump pressure P_1 of the 1st pump 32 is set up conversely lower ($P_1<P_2$) than pump pressure P_2 of the 2nd pump 40, it is confirmed that a substrate center section becomes thin.

[0017]Potential of the surface of cation exchange membrane shows a tendency which becomes equipotential in an operation of an electric field in plating liquid, and the surface of cation exchange membrane will commit this as the temporary anode. Even if a film is not an ion-exchange membrane, even if same result is obtained also with a neutral filter material and it is not a thin film, same result is obtained also for a non-conducting porous plate.

[0018]The invention according to claim 2 is the plating device according to claim 1 which said current plate is plate-like and is characterized by being arranged so that the whole surface of this anode may be covered to said anode and parallel. Thereby, while fixing current density [in / very / the whole surface of a between] on appearance, plating liquid introduced in a plating tub

can flow smoothly along with a current plate. The invention according to claim 3 is the plating device according to claim 1 or 2, wherein said current plate comprises porous membrane of polypropylene, polyethylene, or PTFE, a porous board, or a porous board of ceramics.
[0019]The invention according to claim 4 density of said current plate, It is the plating device according to any one of claims 1 to 3 setting as a size in which plating liquid turns an inside of a current plate caudad, passes with the prudence, and prevents the back run according to a flow of plating liquid introduced in a plating tub. It can be prevented from a black film generated on the surface of an anode flowing backwards a current plate, and reaching on the surface of a substrate by this. The invention according to claim 5 is the plating device according to claim 4, wherein density of said current plate is set as a size in which plating liquid of a flow of 1 - 5 L/min passes an inside of a current plate.
[0020]
[Embodiment of the Invention]Hereafter, an embodiment of the invention is described with reference to drawings. Drawing 4 shows the plating device of an embodiment of the invention. This plating device is approximately cylindrical and mainly comprises the plating tub 50 which accommodates the plating liquid Q in an inside, and the substrate holder 52 which is arranged above this plating tub 50 and holds the substrate W enabling free attachment and detachment. Drawing 1 shows the state when it is in the plating position which held the substrate W by the substrate holder 52, and raised the oil level of the plating liquid Q.
[0021]In the plating tub 50, it opens wide up, the soluble anodes 54, such as phosphorus-containing copper, are arranged at the pars basilaris ossis occipitalis, and it has the plating room 56 which holds the plating liquid Q inside. The plating liquid spray nozzle 60 which projects horizontally toward the center of the plating room 56 in the peripheral wall 58 which carries out section forming of the inner skin of the plating room 56 is arranged at equal intervals along with a circumferencial direction, and this plating liquid spray nozzle 60 is open for free passage to the plating liquid supply route 62 which carried out section forming to the peripheral part of the plating tub 50. This plating liquid supply route 62 is connected to the plating liquid feed pipe which is not illustrated.
[0022]The 2nd plating liquid exhaust passage 66 which discharges the plating liquid Q which overflowed the upper bed part of the peripheral wall 58 which carries out section forming of the 1st plating liquid exhaust passage 64 which draws out the plating liquid Q in the plating room 56 from the periphery of a pars basilaris ossis occipitalis of this plating room 56, and the inner skin of the plating room 56 is established in the plating tub 50. Such plating liquid exhaust passage 64 and 66 is connected to the plating liquid exhaust pipe which is not illustrated.
[0023]It is located in the inside of the plating room 56 of the plating tub 50 down the flat surface which is the upper part of the anode 54 and the plating liquid spray nozzle 60 makes, the current plate 68 is parallel to the anode 54, and it is arranged so that the whole surface of the anode 54 may be covered. The plating room 56 is classified into the substrate side field 56a and the anode side field 56b with the current plate 68 by this (isolation), and the plating liquid Q is introduced by this plating liquid spray nozzle 60 from this substrate side field 56a side.
[0024]This current plate 68 comprises porous membrane of polypropylene, polyethylene, or PTFE (polytetrafluoroethylene), a porous board, or a porous board of ceramics, for example. The density of this current plate 68 is set as the size in which the plating liquid Q turns the inside of the current plate 68 caudad, passes with that prudence, and prevents that back run according to the flow of the plating liquid Q introduced in the plating tub 50.
[0025]That is, the plating liquid Q which was injected from the plating liquid spray nozzle 60, and was introduced into the inside of the plating room 56 collides in the center section of the plating room 56, and is divided into the flow going up and the descending flow. And the flow which descended passes the inside of the current plate 68, flows along the surface of the anode 54, and is caudad discharged from the peripheral part of the anode 54. As for the flow at this time, about

1-5 L/min is desirable, for example, and in order for this flow not to have a back run moreover uniformly and to flow through the inside of the current plate 68, it is necessary to secure the channel corresponding to this flow. For this reason, in this example, by the gravity flow by the head of only the height of the oil level of the plating liquid Q located above the current plate 68, the density of the current plate 68 is set up so that the plating liquid of 1 - 5 L/min may pass the inside of the current plate 68. It can be prevented from the black film generated by the surface of the anode 54 flowing backwards the inside of the current plate 68, and arriving at the surface of the substrate W by this.

[0026]The anode 54 made immersed into the plating liquid Q accommodated in the plating room 56 when this current plate 68 plated on the surface (field to be plated) of the substrate W held by the substrate holder 52, It is located between the surfaces (field to be plated) of the substrate contacted in the plating liquid Q in the plating room 56, and a role of the temporary anode (false anode) is played as mentioned above by this. By thus, the thing made for the current plate 68 to play a role of a false anode. Even if the actual distance between electrodes a, i.e., the distance of the anode 54 and the surface (field to be plated) of a substrate, becomes large gradually with the dissolution of the anode 54 by advance of plating, The distance between electrodes b on appearance, i.e., the distance of the surface of the current plate 68 and the surface (field to be plated) of a substrate, becomes always fixed, and the homogeneity within a field of the plating film formed by plating of this is prevented from changing temporally.

[0027]The current plate 68 is plate-like shape, and arranging in parallel with the substrate W is preferred. Thereby, while making regularity more current density [in / very / the whole surface of a between] on appearance, the plating liquid Q introduced in the plating room 56 of the plating tub 50 can flow smoothly along with the current plate 68. The path of a substrate becomes large, and in order to make the plating liquid injected from a plating liquid spray nozzle arrive at the center section of the plating room, even if it becomes impossible to bring the actual distance between electrodes close, it becomes possible by using a current plate as a false anode to make the apparent distance between electrodes small.

[0028]In this example, even if the punch plates 70 which established the hole of about 3-mm a large number in the upper position of the current plate 68, for example are arranged and the plating liquid Q flows backwards the inside of the current plate 68 by this, the black film formed in the surface of the anode 54 adheres to the substrate W. The punch plates 70 may be arranged to the downward position of the current plate 68, or may be built in a current plate, and do not need to provide a punching plate.

[0029]The housing 72 which has the opening 72a in a peripheral wall by the closed-end cylindrical shape which carried out the opening of the substrate holder 52 caudad, It has the press ring 74 arranged inside this housing 72, this housing 72 is connected with the output shaft of the motor 76, and the press ring 74 is connected with the cylinder rod 80 of the cylinder 78 attached downward at the housing 72. The substrate attaching part 82 of the ring shape which projects in an inner direction is formed in the lower end of the housing 72, and the sealant 84 of the ring shape in which it projects to an inner direction and a tip on top projects in the shape of a steeple up is attached to this substrate attaching part 82. Two or more points of contact 86 for cathode terminals are arranged outside this sealant 84 at the way.

[0030]Where the oil level of the plating liquid Q is lowered with this, after holding the substrate W by an adsorption hand etc., putting into the inside of the housing 72, laying in the upper surface of the sealant 84 of the substrate attaching part 82 and drawing out an adsorption hand from the housing 72, the press ring 74 is dropped. When the edge part of the substrate W is pinched on the undersurface of the sealant 84 and the press ring 74, the substrate W is held by this and the substrate W is moreover held, the undersurface and the sealant 84 of the substrate W weld by pressure, The seal of here is carried out certainly, the seed layer 7 (refer to drawing 24 (a) a) and the point of contact 86 for cathode terminals which were provided in the surface

(field to be plated) of the substrate W energize simultaneously, and the seed layer 7 serves as a cathode.
[0031]Next, the plating processing by this plating device is explained. First, vacuum absorption is canceled, after inserting in this inside the substrate W which turned the surface downward and carried out adsorption maintenance by a carrier robot's adsorption hand and this hand from the opening 72a of the housing 72 and moving an adsorption hand caudad, The substrate W is laid on the substrate attaching part 82 of the housing 72, and after an appropriate time, an adsorption hand is raised and it draws out from the housing 72. Next, the press ring 74 is dropped, the edge part of the substrate W is pinched on the undersurface of the substrate attaching part 82 and the press ring 74, and the substrate W is held.
[0032]And make the plating liquid Q inject from the plating liquid spray nozzle 60, and the housing 72 and the substrate W held at it are simultaneously rotated with medium speed, When several seconds pass, the plating liquid Q is filled to a predetermined quantity, and also it makes the revolving speed of the housing 72 fall to a low speed rotary (for example, 100min^{-1}), and The anode 54, Between the seed layers 7 (refer to drawing 24 (a)) provided in the surface of the substrate W used as a cathode, a plating current is sent and electroplating is performed.
[0033]At this time, the current plate 68 plays a role of a false anode, and plating is governed as mentioned above, by the current density between the seed layers 7 provided in the surface of this current plate (false anode) 68 and the substrate W, and by this. Even if the anode 54 dissolves according to advance of plating, the distance between electrodes b on appearance, i.e., the distance of the surface of the current plate 68 and the surface (field to be plated) of a substrate, becomes always fixed, and the homogeneity within a field of the plating film formed by plating does not change temporally.
[0034]After ending plating, the plating liquid Q of the plating room 56 is drained, and the substrate W held at the housing 72 and it is exposed. In this state, the housing 72 and the substrate W held at it are rotated at high speed (for example, $500 - 800\text{min}^{-1}$), and the liquid end of the plating liquid is carried out according to a centrifugal force. After the liquid end is completed, as the housing 72 is suitable in the predetermined direction, rotation of the housing 72 is stopped.
[0035]After the housing 72 stops thoroughly, the press ring 74 is raised. Next, a carrier-robot adsorption hand etc. are turned downward, an adsorption face is inserted in this inside from the opening 72a of the housing 72, and an adsorption hand is dropped even to the position in which an adsorption hand can adsorb a substrate. And vacuum absorption of the substrate is carried out by an adsorption hand, an adsorption hand is moved to the upper part of the opening 72a of the housing 72, and an adsorption hand and the substrate held to it are taken out from the opening 72a of the housing 72.
[0036]Drawing 5 shows the plane configuration figure of the substrate processing device provided with the above-mentioned plating device. This substrate processing device possesses carrying-in / taking-out area 520 which delivers the substrate cassette which accommodated the semiconductor substrate, the process areas 530 which perform process treatment, and washing and drying area 540 which perform washing and desiccation of the semiconductor substrate after process treatment so that it may illustrate. Washing and the drying area 540 are arranged between carrying-in / taking-out area 520 and the process areas 530. The septum 521 was formed in carrying-in / taking-out area 520, and washing and drying area 540, and the septum 523 is formed between washing and the drying area 540, and the process areas 530.
[0037]The passage (not shown) for delivering a semiconductor substrate between carrying-in / taking-out area 520, and washing and drying area 540 was established in the septum 521, and the shutter 522 for opening and closing this passage is formed in it. The passage (not shown) for delivering a semiconductor substrate also to the septum 523 between washing and the drying

area 540, and the process areas 530 was provided, and the shutter 524 for opening and closing this passage is formed. Washing and the drying area 540, and the process areas 530 have come to be able to carry out air supply and exhaust uniquely.
[0038]The substrate processing device for semiconductor substrate wiring of the above-mentioned composition is installed in a clean room, and the pressure of each area is >(pressure of carrying-in / taking-out area 520) (pressure of washing and drying area 540) > (pressure of the process areas 530).
It is alike, and is set up and the pressure of carrying-in / taking-out area 520 is set up lower than clean room internal pressure. Keep air from flowing out of the process areas 530 into washing and the drying area 540, air is kept from flowing out of washing and the drying area 540 into carrying-in / taking-out area 520 by this, and air is kept from flowing out of carrying-in / taking-out area 520 in a clean room further.
[0039]The load unit 520a and the unloading unit 520b which store the substrate cassette which accommodated the semiconductor substrate in carrying-in / taking-out area 520 are arranged. Two sets each of the rinsing sections 541 and the dryer part 542 which perform processing after plating processing are arranged, and washing and the drying area 540 are equipped with the transportation part (carrier robot) 543 which conveys a semiconductor substrate. As the rinsing section 541, the pencil type thing and the thing of a roller-type type with sponge which sponge attached, for example to the front end are used here. The thing of form which carries out spin at high speed, dries and dries a semiconductor substrate as the dryer part 542, for example is used. In the process areas 530, the pretreatment tub 531 which pretreats plating of a semiconductor substrate, and the plating tub (plating device) 532 which performs copper plating treatment are arranged, and it has the transportation part (carrier robot) 533 which conveys a semiconductor substrate.
[0040]Drawing 6 shows the flow of the air current in a substrate processing device. In washing and the drying area 540, exterior air fresher than the piping 546 is incorporated, it is pushed in by a fan through the high efficiency filter 544, and the circumference of the rinsing section 541 and the dryer part 542 is supplied as a clean air of a downflow from the ceiling 540a. Most supplied clean airs are returned to the ceiling 540a side by the circulating piping 545 from the floor 540b, it is again pushed in by a fan through the high efficiency filter 544, and circulates in washing and the drying area 540. Some air currents are exhausted through the duct 552 from the inside of the rinsing section 541 and the dryer part 542.
[0041]Though the process areas 530 call it a wet zone, particle is not allowed to adhere to a semiconductor substrate surface. For this reason, particle is prevented from adhering to a semiconductor substrate by being pushed in by a fan and passing the clean air of a downflow through the high efficiency filter 533 from the ceiling 530a, in the process areas 530. However, when it depends on the air supply and exhaust from the outside for the full flow of the clean air which forms a downflow, the huge amount of air supply and exhaust is needed. For this reason, he considers only exhaust air of the grade which maintains the interior of a room at negative pressure as external exhaust air [duct / 553], and is trying to provide the air current of most downflows with the circulating current of air through the piping 534,535.
[0042]When it is considered as a circulating current of air, since the clean air which passed the process areas 530 contains drug solution mist and a gas, it removes this through the scrubber 536 and MITOSEPARETA 537,538. The exhaust air which returned to the circulation duct 534 by the side of the ceiling 530a by this becomes what contains neither drug solution mist nor a gas, is again pushed in by a fan, and it circulates through it as a clean air in the process areas 530 through the high efficiency filter 533. A part of exhaust air which passed along the inside of the process areas 530 from the floor 530b is discharged outside through the duct 553, and the exhaust air containing drug solution mist and a gas is discharged outside through the duct 553. From the duct 539 of the ceiling 530a, the fresh air corresponding to such displacement is

supplied to the grade maintained at negative pressure in the process areas 530.
[0043]Each pressure of carrying-in / taking-out area 520, washing and drying area 540, and the process areas 530 is >(pressure of carrying-in / taking-out area 520) (pressure of washing and drying area 540) > (pressure of the process areas 530) as mentioned above.
It is alike and is set up. Therefore, if the shutter 522,524 (refer to drawing 5) is opened, the flow of the air between these area will flow in order of carrying-in / taking-out area 520, washing and drying area 540, and the process areas 530, as shown in drawing 6. Exhaust air lets the ducts 552 and 553 pass, and as shown in drawing 8, it is brought together in the set exhaust duct 554.

[0044]Drawing 7 is an outline view in which a substrate processing device shows an example arranged in a clean room. The side in which there are the cassette delivery mouth 555 of carrying-in / taking-out area 520 and the navigational panel 556 is exposed to the high working zone 558 of the air cleanliness class of the clean room divided with the bridge wall 557, and the other sides are stored by the low utility zone 559 of the air cleanliness class.
[0045]As mentioned above, washing and the drying area 540 are arranged between carrying-in / taking-out area 520 and the process areas 530, Since the septum 521 was formed, respectively between carrying-in / taking-out area 520, and washing and drying area 540 and between washing and the drying area 540, and the process areas 530, The semiconductor substrate carried in in the substrate processing device for semiconductor substrate wiring through the cassette delivery mouth 555 in the state where it dried, from the working zone 558, Since it is taken out in the working zone 558 in the state where plating processing was carried out, and it washed and dried within the substrate processing device, The high working zone 558 of the air cleanliness class in a clean room is not polluted with particle, a drug solution, or penetrant remover mist, without particle and mist adhering to a semiconductor substrate side.
[0046]Although the substrate processing device showed the example possessing carrying-in / taking-out area 520, washing and drying area 540, and the process areas 530 by drawing 5 and drawing 6, The area which adjoins the inside of the process areas 530 or the process areas 530, and arranges a CMP device may be provided, and it may constitute so that washing and the drying area 540 may be arranged between the area which arranges these process areas 530 or a CMP device, and carrying-in / taking-out area 520. What is necessary is just the composition discharged in the state where the semiconductor substrate was carried in to the substrate processing device for semiconductor substrate wiring by dryness in short, the semiconductor substrate which plating processing ended was washed, and it dried.
[0047]In the above-mentioned example, a substrate is not limited to a semiconductor substrate and a substrate processing device is not limited to the wiring section which was formed on the substrates face as for the portion which carries out plating processing, although the plating device for semiconductor substrate wiring was explained to the example. Although the above-mentioned example explained copper plating to the example, it is not limited to copper plating.
[0048]Drawing 9 is a figure showing the plane constitution of other substrate processing devices for semiconductor substrate wiring. So that it may illustrate the substrate processing device for semiconductor substrate wiring, A semiconductor substrate. The carrying out portion 609 which takes out the semiconductor substrate which the carrying in part 601 to carry in, the copper-plating tub 602 which performs copper plating, the rinse tank 603,604 which performs backwashing by water, the CMP section 605 which performs chemical machinery polish (CMP), the rinse tank 606,607, the dry tub 608, and wiring layer formation ended is provided, The substrate transporting means which transports a semiconductor substrate to these each tub and which is not illustrated is arranged as one device, and constitutes the substrate processing device for semiconductor substrate wiring.
[0049]In the substrate processing device of the above-mentioned arrangement configuration, by a substrate transporting means, the semiconductor substrate in which the wiring layer is not

formed is taken out from the substrate cassette 601-1 laid in the carrying in part 601, and it transports to the copper-plating tub 602. In this copper-plating tub 602, a copper plating layer is formed on the surface of the semiconductor substrate W including the wiring section which consists of a wiring gutter or a wiring hole (contact hole).

[0050]It rinses by said copper plating layer 602 by transporting the semiconductor substrate W which formation of the copper plating layer ended to the rinse tank 603 and the rinse tank 604 by a substrate transporting means. Then, the semiconductor substrate W which this backwashing by water ended is transported to the CMP section 605 by a substrate transporting means, it leaves the copper plating layer formed in the wiring gutter or the wiring hole from the copper plating layer in this CMP section 605, and the copper plating layer on the surface of the semiconductor substrate W is removed.

[0051]Then, the semiconductor substrate W which left the copper plating layer formed in the wiring section which consists of a wiring gutter or a wiring hole from the copper plating layer as mentioned above, and removal of the unnecessary copper plating layer on the surface of the semiconductor substrate W ended. Backwashing by water is sent and carried out to the rinse tank 606 and the rinse tank 607 by a substrate transporting means, and also the semiconductor substrate W which backwashing by water ended is dried by the dry tub 608, and the semiconductor substrate W which desiccation ended is stored in the substrate cassette 609-1 of the carrying out portion 609 as a semiconductor substrate which formation of the wiring layer ended.

[0052]Drawing 10 is a figure showing the plane constitution of other substrate processing devices for semiconductor substrate wiring. The point that the substrate processing device shown in drawing 10 differs from the device shown in drawing 9 is a point which added the copper-plating tub 602, the lid plating tub 612 which forms a protective film in the surface of a copper-plating film, the CMP section 615, and the rinse tanks 613 and 614, and was constituted as one device including these.

[0053]In the substrate processing device of the above-mentioned arrangement configuration, a copper plating layer is formed on the surface of the semiconductor substrate W including the wiring section which consists of a wiring gutter or a wiring hole (contact hole). Then, it leaves the copper plating layer formed in the wiring gutter or the wiring hole from the copper plating layer in the CMP section 605, and the copper plating layer on the surface of the semiconductor substrate W is removed.

[0054]Then, the semiconductor substrate W which left the copper plating layer formed in the wiring section which consists of a wiring gutter or a wiring hole from the copper plating layer as mentioned above, and removed the copper plating layer on the surface of the semiconductor substrate W is transported to the rinse tank 610, and backwashing by water is carried out here. Then, pretreatment for performing lid plating mentioned later by the pretreatment tub 611 is performed. The semiconductor substrate W which this pretreatment ended is transported to the lid plating tub 612, and a protective film is formed on the copper plating layer formed in the wiring section by the lid plating tub 612. As this protective film, a nickel-B nonelectrolytic plating tub is used, for example. After forming a protective film, backwashing by water of the semiconductor substrate W is carried out with the rinse tank 606,607, and also it is made to dry by the dry tub 608. And after grinding and carrying out flattening of the upper part of the protective film formed on the copper plating layer in the CMP section 615 and carrying out backwashing by water with the rinse tank 613,614, it is made to dry by the dry tub 608, and the semiconductor substrate W is stored in the substrate cassette 609-1 of the carrying out portion 609.

[0055]Drawing 11 is a figure showing the planar structure of other substrate processing devices for semiconductor substrate wiring. This substrate processing device arranges the robot 616 in the center so that it may illustrate, The copper-plating tub 602 which carries out copper plating

to the range which the robot arm 616-1 of the circumference reaches, the rinse tank 603, the rinse tank 604, the CMP section 605, the lid plating tub 612, the dry tub 608, and the load unload part 617 are arranged, and it constitutes as one device. The load unload part 617 is adjoined and the carrying in part 601 and the carrying out portion 609 of the semiconductor substrate are arranged.

[0056]In the substrate processing device for semiconductor substrate wiring of the above-mentioned composition, the semiconductor substrate with which wiring plating cannot be managed from the carrying in part 601 of the semiconductor substrate is transported to the load unload part 617, The robot arm 616-1 receives this semiconductor substrate, it transports to the copper-plating tub 602, and a copper plating layer is formed on the surface of a semiconductor substrate including the wiring section which consists of a wiring gutter or a wiring hole by this plating tub. The semiconductor substrate in which this copper plating layer was formed is transported to the CMP section 605 by the robot arm 616-1, it leaves the copper plating layer formed in the wiring section which consists of a wiring gutter or a wiring hole from a copper plating layer in this CMP section 605, and the excessive copper plating layer on the surface of the semiconductor substrate W is removed.

[0057]After rinsing treatment of the semiconductor substrate from which the copper plating layer with the excessive surface was removed is transported and carried out to the rinse tank 604 by the robot arm 616-1, it is transported to the pretreatment tub 611 and pretreatment before covering plating is performed by this pretreatment tub 611. By the robot arm 616-1, the semiconductor substrate which this pretreatment ended is transported to the covering plating bath 612, it is this covering plating bath 612, and is formed in the wiring section which consists of a wiring gutter or a wiring hole, and forms a protective film on a copper plating layer. The semiconductor substrate in which the protective film was formed is transported to the load unload part 617, after being transported to the dry tub 608 after it is transported to the rinse tank 604 and rinsing treatment is carried out by the robot arm 616-1 here, and drying.The semiconductor substrate which this wiring plating ended is transported to the carrying out portion 609.

[0058]Drawing 12 is a figure showing the plane constitution of other semiconductor substrate processing units. This semiconductor substrate processing unit, The load unload part 701, the copper-plating unit 702, the 1st robot 703, the 3rd soaping machine 704, the reversal machine 705, the reversal machine 706, the 2nd soaping machine 707, the 2nd robot 708, the 1st soaping machine 709, the 1st polishing device 710, and the 2nd polishing device 711. It is the arranged composition. Near the 1st robot 703, the order [plating] thickness measurement machine 712 which measures the thickness before and behind plating, and the dryness thickness measurement machine 713 which is after polish and measures the thickness of the semiconductor substrate W of dryness are arranged.

[0059]The 1st polishing device (grinding unit) 710 possesses the polishing table 710-1, the top ring 710-2, the top ring head 710-3, the thickness measurement machine 710-4, and the pusher 710-5. The 2nd polishing device (grinding unit) 711 possesses the polishing table 711-1, the top ring 711-2, the top ring head 711-3, the thickness measurement machine 711-4, and the pusher 711-5.

[0060]The cassette 701-1 which accommodated the semiconductor substrate W by which the contact hole and the slot for wiring were formed and the seed layer was formed on it is laid in the load port of the load unload part 701. The 1st robot 703 takes out the semiconductor substrate W from the cassette 701-1, carries it in to the copper-plating unit 702, and forms a copper-plating film. The thickness of a seed layer is then measured with the thickness measurement machine 712 before and after plating. Membrane formation of a copper-plating film performs hydrophilic processing of the surface of the semiconductor substrate W first, and forms by performing copper plating after that. The copper-plating unit 702 performs rinse or washing

after formation of a copper-plating film. It may dry, as long as time has a margin.
[0061]When the semiconductor substrate W is taken out from the copper-plating unit 702 by the 1st robot 703, the thickness of a copper-plating film is measured with the thickness measurement machine 712 before and after plating. The measurement result is recorded on a recorder (not shown) as record data of a semiconductor substrate, and, moreover, is used also for the judgment of the abnormalities of the copper-plating unit 702. After thickness measurement, the 1st robot 703 passes the semiconductor substrate W to the reversal machine 705, and makes it reversed with this reversal machine 705 (the field in which the copper-plating film was formed turns down). There are a series mode and a parallel mode in polish by the 1st polishing device 710 and the 2nd polishing device 711. Hereafter, polish of a series mode is explained.
[0062]Series mode polish is polish which performs primary polish with the polishing device 710, and performs secondary polish with the polishing device 711. The semiconductor substrate W on the reversal machine 705 is taken up by the 2nd robot 708, and the semiconductor substrate W is carried on the pusher 710-5 of the polishing device 710. The top ring 710-2 adsorbs this semiconductor substrate W on the pusher 710-5, carries out the contact press of the copper-plating film formation side of the semiconductor substrate W, and performs primary polish to the polished surface of the polishing table 710-1. In this primary polish, a copper-plating film is ground fundamentally. The polished surface of the polishing table 710-1 fixes or impregnated with foaming polyurethane like IC1000, or an abrasive grain, and is constituted. A copper-plating film is ground by the relative motion of this polished surface and the semiconductor substrate W.
[0063]The semiconductor substrate W is returned on the pusher 710-5 by the top ring 710-2 after the grinding completion of a copper-plating film. The 2nd robot 708 takes up this semiconductor substrate W, and puts it into the 1st soaping machine 709. And it may be made hard to attach. [injecting a drug solution at the surface and the rear face of the semiconductor substrate W on the pusher 710-5 at this time, and removing particle]
[0064]In the 1st soaping machine 709, the semiconductor substrate W is taken up by the 2nd robot 708 after the end of washing, and the semiconductor substrate W is carried on the pusher 711-5 of the 2nd polishing device 711. The semiconductor substrate W on the pusher 711-5 is adsorbed by the top ring 711-2, the contact press of the field in which the barrier layer of this semiconductor substrate W was formed is carried out at the polished surface of the polishing table 711-1, and secondary polish is performed. A barrier layer is ground in this secondary polish. However, there is also a case where the copper film which remained by the above-mentioned primary polish, and an oxide film are also ground.
[0065]The polished surface of the polishing table 711-1 fixes or impregnated with foaming polyurethane like IC1000, or an abrasive grain, is constituted, and is ground by the relative motion of this polished surface and the semiconductor substrate W. Silica, alumina, Seria, etc. are used for an abrasive grain or a slurry at this time. A drug solution is adjusted with a membrane type to grind.
[0066]The thickness of a barrier layer is measured using an optical thickness measurement machine, and detection of the terminal point of secondary polish is performed by surface detection of the insulator layer which consists of that thickness was set to 0, or SiO_2. As the thickness measurement machine 711-4 formed near the polishing table 711-1, using a thickness measurement machine with an image processing function, an oxide film is measured and it is judged whether it can leave as processing record of the semiconductor substrate W, or the semiconductor substrate W which secondary polish ended can be transported to the following process. When it regrinds when a secondary polishing end point is not arrived at, or it is ground exceeding default value by a certain abnormalities, a semiconductor substrate processing unit is stopped so that inferior goods may not be increased and the next polish may not be performed.
[0067]Even the pusher 711-5 moves the semiconductor substrate W by the top ring 711-2 after

secondary grinding completion. The semiconductor substrate W on the pusher 711-5 is taken up by the 2nd robot 708. It may be made hard to inject a drug solution at the surface and the rear face of the semiconductor substrate W on the pusher 711-5, and to remove particle at this time, or to attach.

[0068]The 2nd robot 708 washes by carrying in the semiconductor substrate W to the 2nd soaping machine 707. The composition of the 2nd soaping machine 707 is also the same composition as the 1st soaping machine 709. Cleaning by scrubbing of the surface of the semiconductor substrate W is mainly carried out to pure water by a PVA sponge roll using the penetrant remover which added the surface-active agent, the chelating agent, and the pH adjuster for particle removal. If the copper which blew off and has diffused strong drug solutions, such as DHF, is etched into the rear face of the semiconductor substrate W from a nozzle or there is no problem of diffusion in it, cleaning by scrubbing by a PVA sponge roll will be carried out using the same drug solution as the surface.

[0069]The semiconductor substrate W is taken up by the 2nd robot 708 after the end of the above-mentioned washing, and it moves to the reversal machine 706, and is made reversed with this reversal machine 706. The reversed this semiconductor substrate W is taken up by the 1st robot 703, and it puts into the 3rd soaping machine 704. In the 3rd soaping machine 704, the megasonic water excited by the surface of the semiconductor substrate W by supersonic vibration is injected and washed. Publicly known pencil type sponge may wash the surface of the semiconductor substrate W using the penetrant remover which added the surface-active agent, the chelating agent, and the pH adjuster to pure water then. Then, the semiconductor substrate W is dried by spin drying. When thickness is measured with the thickness measurement machine 711-4 formed near the polishing table 711-1 as mentioned above, it accommodates in the cassette laid in the unloading port of the load unload part 701 as it is.

[0070]Drawing 13 is a figure showing the plane constitution of other semiconductor substrate processing units. A different point from the semiconductor substrate processing unit shown in drawing 12 of this semiconductor substrate processing unit is a point of having formed the lid plating unit 750 instead of the copper-plating unit 702 shown in drawing 12. The cassette 701-1 which accommodated the semiconductor substrate W in which the copper film was formed is laid in the load unload part 701. The semiconductor substrate W is taken out from the cassette 701-1, it is conveyed by the 1st polishing device 710 or the 2nd polishing device 711, and the surface of a copper film is ground here. The semiconductor substrate W is conveyed and washed by the 1st soaping machine 709 after this grinding completion.

[0071]A copper-plating film is prevented from the semiconductor substrate W washed with the 1st soaping machine 709 being conveyed by the lid plating unit 750, and a protective film being formed in the surface of a copper-plating film here, and oxidizing in the atmosphere by this. By the 2nd robot 708, the semiconductor substrate W which performed lid plating is conveyed by the 2nd soaping machine 707 from the lid plating unit 750, and is washed by pure water or deionized water here. The semiconductor substrate W after this washing is returned to the cassette 701-1 laid in the load unload part 701.

[0072]Drawing 14 is a figure showing the plane constitution of the semiconductor substrate processing unit of further others. A different point from the semiconductor substrate processing unit shown in drawing 13 of this semiconductor substrate processing unit is a point of having formed the annealing unit 751 instead of the 1st soaping machine 709 shown in drawing 13. The semiconductor substrate W which was ground with the 1st polishing device 710 or the 2nd polishing device 711 as mentioned above, and was washed with the 2nd soaping machine 707 is conveyed by the lid plating unit 750, and lid plating is performed to the surface of a copper-plating film here. By the 1st robot 703, from the lid plating unit 750, the semiconductor substrate W to which this lid plating was performed is conveyed by the 3rd soaping machine 704, and is washed here.

[0073]The semiconductor substrate W washed with the 1st soaping machine 709 is conveyed by the annealing unit 751, and is annealed here. A copper-plating film is alloyed by this and the electron migration tolerance of a copper-plating film improves by it. The semiconductor substrate W to which annealing was given is conveyed by the 2nd soaping machine 707 from the annealing unit 751, and is washed by pure water or deionized water here. The semiconductor substrate W after this washing is returned to the cassette 701-1 laid in the load unload part 701.
[0074]Drawing 15 is a figure showing other plane configuration composition of a substrate processing device. In drawing 15, the portion which attached drawing 12 and identical codes shows a same or considerable portion. This substrate polish device approaches the 1st polishing device 710 and the 2nd polishing device 711, and arranges the pusher indexer 725, The substrate mounting bases 721 and 722 are arranged near the 3rd soaping machine 704 and the copper-plating unit 702, respectively, The robot 723 has been arranged near the 1st soaping machine 709 and the 3rd soaping machine 704, and the robot 724 has been arranged near the 2nd soaping machine 707 and the copper-plating unit 702, and also the dryness thickness measurement machine 713 is arranged near the load unload part 701 and the 1st robot 703.
[0075]In the substrate processing device of the above-mentioned composition, the 1st robot 703, After taking out the semiconductor substrate W from the cassette 701-1 currently laid in the load port of the load unload part 701 and measuring the thickness of a barrier layer and a seed layer with the dryness thickness measurement machine 713, this semiconductor substrate W is put on the substrate mounting base 721. When the dryness thickness measurement machine 713 is formed in the hand of the 1st robot 703, it measures thickness there and puts on the substrate mounting base 721. The semiconductor substrate W on the substrate mounting base 721 is transported to the copper-plating unit 702 by the 2nd robot 723, and a copper-plating film is formed. The thickness of a copper-plating film is measured with the thickness measurement machine 712 before and after plating after membrane formation of a copper-plating film. Then, the semiconductor substrate W is transported to the pusher indexer 725, and the 2nd robot 723 carries it.
[0076][Series mode] In a series mode, the semiconductor substrate W on the pusher indexer 725 is adsorbed, and it transports to the polishing table 710-1, and the top ring head 710-2 presses this semiconductor substrate W to the polished surface on the polishing table 710-1, and grinds to it. Terminal point detection of polish is performed by the same method as the above, and the semiconductor substrate W after grinding completion is transported and carried in the pusher indexer 725 by the top ring head 710-2. The semiconductor substrate W is taken out by the 2nd robot 723, and it carries in, washes and carries [transport and] in the 1st soaping machine 709 in the pusher indexer 725 continuously.
[0077]The semiconductor substrate W on the pusher indexer 725 is adsorbed, and it transports to the polishing table 711-1, and the top ring head 711-2 presses this semiconductor substrate W to the polished surface, and grinds to it. Terminal point detection of polish is performed by the same method as the above, and the semiconductor substrate W after grinding completion is transported and carried in the pusher indexer 725 by the top ring head 711-2. After taking up the semiconductor substrate W and measuring thickness with the thickness measurement machine 726, the 3rd robot 724 is carried in to the 2nd soaping machine 707, and is washed. Then, it carries in to the 3rd soaping machine 704, after washing here, it dries by spin-dry, and the semiconductor substrate W is taken up by the 3rd robot 724 after that, and it carries on the substrate mounting base 722.
[0078][Parallel mode] In a parallel mode, the top ring head 710-2 or 711-2 adsorbs the semiconductor substrate W on the pusher indexer 725, It transports to the polishing table 710-1 or 711-1, and this semiconductor substrate W is pressed to the polished surface on the polishing table 710-1 or 711-1, and it grinds to it, respectively. After measuring thickness, the semiconductor substrate W is taken up by the 3rd robot 724, and it carries on the substrate

mounting base 722. After the 1st robot 703 transports the semiconductor substrate W on the substrate mounting base 722 to the dryness thickness measurement machine 713 and measures thickness, it is returned to the cassette 701-1 of the load unload part 701.

[0079]Drawing 16 is a figure showing other plane configuration composition of a substrate processing device. It is a substrate processing device which forms and grinds a seed layer and a copper-plating film in this substrate processing device to the semiconductor substrate W in which the seed layer is not formed, and forms circuit wiring. This substrate polish device approaches the 1st polishing device 710 and the 2nd polishing device 711, and arranges the pusher indexer 725, The substrate mounting bases 721 and 722 are arranged near the 2nd soaping machine 707 and the seed layer forming unit 727, respectively, The seed layer forming unit 727 and the copper-plating unit 702 were approached, the robot 723 has been arranged, and the robot 724 has been arranged near the 1st soaping machine 709 and the 2nd soaping machine 707, and also the dry membrane thickness measuring apparatus 713 is arranged near the load unload part 701 and the 1st robot 703.

[0080]The semiconductor substrate W in which the barrier layer is formed is taken out from the cassette 701-1 currently laid in the load port of the load unload part 701 by the 1st robot 703, and it puts on the substrate mounting base 721. Next, the 2nd robot 723 conveys the semiconductor substrate W to the seed layer forming unit 727, and forms a seed layer. Nonelectrolytic plating performs membrane formation of this seed layer. The 2nd robot 723 measures the thickness of a seed layer for the semiconductor substrate in which the seed layer was formed with the thickness measurement machine 712 before and after plating. It carries in to the copper-plating unit 702 after thickness measurement, and a copper-plating film is formed.

[0081]The thickness is measured after forming a copper-plating film, and it transports to the pusher indexer 725. The top ring 710-2 or 711-2 adsorbs the semiconductor substrate W on the pusher indexer 725, is transported to the polishing table 710-1 or 711-1, and is ground. After polish, the top ring 710-2 or 711-2 transports the semiconductor substrate W to the thickness measurement machine 710-4 or 711-4, measures thickness, and transports and puts it on the pusher indexer 725.

[0082]Next, the 3rd robot 724 takes up the semiconductor substrate W from the pusher indexer 725, and carries it in to the 1st soaping machine 709. The semiconductor substrate which the 3rd robot 724 took up the semiconductor substrate W washed from the 1st soaping machine 709, carried it in to the 2nd soaping machine 707, was washed, and was dried is laid on the substrate mounting base 722. Next, the 1st robot 703 takes up the semiconductor substrate W, measures thickness with the dryness thickness measurement machine 713, and stores it to the cassette 701-1 currently laid in the unloading port of the load unload part 701.

[0083]Also in the substrate processing device shown in drawing 16, on the semiconductor substrate W in which the contact hole or slot on the circuit pattern was formed, a barrier layer, a seed layer, and a copper-plating film can be formed and ground, and circuit wiring can be formed. The cassette 701-1 which accommodated the semiconductor substrate W before barrier layer formation is laid in the load port of the load unload part 701. And from the cassette 701-1 currently laid in the load port of the load unload part 701 by the 1st robot 703, the semiconductor substrate W is taken out and it puts on the substrate mounting base 721. Next, the 2nd robot 723 conveys the semiconductor substrate W to the seed layer forming unit 727, and forms a barrier layer and a seed layer. Nonelectrolytic plating performs membrane formation of this barrier layer and a seed layer. The 2nd robot 723 measures the thickness of the barrier layer formed in the semiconductor substrate W with the thickness measurement machine 712 before and after plating, and a seed layer. It carries in to the copper-plating unit 702 after thickness measurement, and a copper-plating film is formed.

[0084]Drawing 17 is a figure showing other plane configuration composition of a substrate processing device. This substrate processing device, The barrier layer forming unit 811, the seed

layer forming unit 812, the plating unit 813, the annealing unit 814, the 1st washing unit 815, a bevel and a rear-face washing unit 816, the lid plating unit 817, the 2nd washing unit 818, the 1st aligner and film thickness gage 841, The 2nd aligner and film thickness gage 842, the 1st substrate reversal machine 843, the 2nd substrate reversal machine 844, the substrate temporary placing stand 845, the 3rd film thickness gage 846, the load unload part 820, the 1st polishing device 821, the 2nd polishing device 822, the 1st robot 831, the 2nd robot 832, It is the composition which has arranged the 3rd robot 833 and the 4th robot 834. The film thickness gage 841,842,846 is a unit, and since the same size as the frontage size of other units (units, such as plating, washing, and annealing) is chosen, it can be replaced freely. In this example, a non-electrolytic copper plating device can be used for unelectrolyzed Ru plating device and the seed layer forming unit 812, and, as for the plating unit 813, an electrolysis plating device can be used for the barrier layer forming unit 811.

[0085]Drawing 18 is a flow chart which shows the flow of each process within this substrate processing device. Each process within this device is explained according to this flow chart. First, the semiconductor substrate taken out from the cassette 820a laid in the load unloading unit 820 by the 1st robot 831 turns a field to be plated up into the 1st aligner and thickness measurement unit 841, and is arranged. Here, in order to define the reference point of the position which performs thickness measurement, after performing notch alignment for thickness measurement, the thickness data of the semiconductor substrate before copper film formation is obtained.

[0086]Next, a semiconductor substrate is conveyed by the 1st robot 831 to the barrier layer forming unit 811. This barrier layer forming unit 811 is a device which forms a barrier layer on a semiconductor substrate with unelectrolyzed Ru plating, and forms Ru as a copper diffusion preventing film to the interlayer insulation film (for example, SiO_2) of a semiconductor device. The semiconductor substrate paid out through washing and a drying process is conveyed by the 1st aligner and thickness measurement unit 841 with the 1st robot 831, and has the thickness of a semiconductor substrate, i.e., the thickness of a barrier layer, measured.

[0087]The semiconductor substrate by which thickness measurement was carried out is carried in to the seed layer forming unit 812 by the 2nd robot 832, and a seed layer is formed by non-electrolytic copper plating on said barrier layer. Before the semiconductor substrate paid out through washing and a drying process is conveyed with the 2nd robot 832 by the plating unit 813 which is an impregnating plating unit, in order to define a notch position, it is conveyed by the 2nd aligner and film thickness gage 842, and aligns the notch for copper plating. Here, the thickness of the semiconductor substrate before copper film formation may be re-measured if needed.

[0088]The semiconductor substrate which notch alignment completed is conveyed by the 3rd robot 833 to the plating unit 813, and copper plating is given. The semiconductor substrate paid out through washing and a drying process is conveyed to a bevel and the rear-face washing unit 816, in order for the 3rd robot 833 to remove the copper film (seed layer) which does not need a semiconductor substrate end. In a bevel and the rear-face washing unit 816, while etching a bevel in time set up beforehand, drug solutions, such as fluoric acid, wash copper adhering to a semiconductor substrate rear face. Before conveying to a bevel and the rear-face washing unit 816 at this time, thickness measurement of a semiconductor substrate is carried out with the 2nd aligner and film thickness gage 842, the value of the copper film thickness formed by plating is obtained, and it may etch by changing the etching time of a bevel arbitrarily by that result. The field etched by bevel etching is an edge part of a substrate, and is a field which is not eventually used as a chip even if the field in which a circuit is not formed, or the circuit is formed. A bevel portion is contained in this field.

[0089]The semiconductor substrate paid out through washing and a drying process with the bevel and the rear-face washing unit 816, After being conveyed by the substrate reversal machine 843 by the 3rd robot 833, being reversed with this substrate reversal machine 843 and

turning a field to be plated caudad, in order to stabilize a wiring section with the 4th robot 834, it is supplied to the annealing unit 814. The thickness of a copper film which carried in to the 2nd aligner and thickness measurement unit 842 before annealing treatment and/or after processing, and was formed in the semiconductor substrate is measured. Then, a semiconductor substrate is carried in to the 1st polishing device 821 by the 4th robot 834, and performs polish of the copper layer of a semiconductor substrate, and a seed layer.

[0090]Under the present circumstances, bonded abrasive can also be used, in order that abrasive grains may prevent dishing and may take out surface flatness, although a desired thing is used. After the end of the 1st polishing, a semiconductor substrate is conveyed by the 1st washing unit 815 with the 4th robot 834, and is washed. It is cleaning by scrubbing washed while passing pure water or deionized water, this washing arranging the roll which has the almost same length as a semiconductor substrate diameter at the surface and the rear face of a semiconductor substrate, and rotating a semiconductor substrate and a roll.

[0091]A semiconductor substrate is carried in to the 2nd polishing device 822 by the 4th robot 834 after the 1st end of washing, and the barrier layer on a semiconductor substrate is ground. Under the present circumstances, bonded abrasive can also be used, in order that abrasive grains may prevent dishing and may take out surface flatness, although a desired thing is used. Cleaning by scrubbing of the semiconductor substrate is again conveyed and carried out to the 1st washing unit 815 by the 4th robot 834 after the end of the 2nd polishing. After the end of washing, it is conveyed by the 2nd substrate reversal machine 844 with the 4th robot 834, it is reversed, and the semiconductor substrate can turn a field to be plated up, and also is put on the substrate temporary placing stand 845 by the 3rd robot 833.

[0092]A semiconductor substrate is conveyed by the lid plating unit 817 from the substrate temporary placing stand 845 with the 2nd robot 832, and performs nickel boron plating on a copper surface for the purpose of antioxidizing by the copper atmosphere. The semiconductor substrate to which lid plating was performed is carried in to the 3rd film thickness gage 846 from the lid plating unit 817 by the 2nd robot 832, and copper film thickness is measured. Then, a semiconductor substrate is carried in to the 2nd washing unit 818 by the 1st robot 831, and is washed by pure water or deionized water. The semiconductor substrate which washing ended is returned in the cassette 820a laid in the load unload part 820 by the stand 1 robot 831. The aligner and film thickness gage 841 and the aligner and film thickness gage 842 perform positioning of a substrate notch portion, and measurement of thickness.

[0093]Edge (bevel) copper etching and rear-face washing can be performed simultaneously, and a bevel and the rear-face washing unit 816 can suppress growth of the natural oxidation film of copper of the circuit formation part of a substrate face. The schematic diagram of a bevel and the rear-face washing unit 816 is shown in drawing 19. As shown in drawing 19, a bevel and the rear-face washing unit 816 are provided with the following.

The substrate attaching part 922 which holds the substrate W horizontally by the spin chuck 921 and to which it is located in the inside of the raintight cover 920 of closed-end cylindrical shape, and a high velocity revolution is carried out at two or more places which met the circumferencial direction of the edge part by face up.

The center nozzle 924 by the side of the surface of the substrate W held by this substrate attaching part 922 arranged mostly in the center-section upper part.

The edge nozzle 926 arranged above the edge part of the substrate W.

The center nozzle 924 and the edge nozzle 926 are arranged downward, respectively. the rear-face side of the substrate W -- it is mostly located down the center section and the back nozzle 928 is arranged upward. Said edge nozzle 926 is constituted in the diametral direction and height direction of the substrate W, enabling free movement.

[0094]Positioning arbitrary from the peripheral end face of a substrate to the direction of the central part is attained, and the moving width L of this edge nozzle 926 inputs a preset value

according to a size, the purpose, etc. of using the substrate W. Usually, edge cut width C is set up in 2 to 5 mm, and if it is more than the number of rotations from which the amount of surroundings lumps of the liquid from a rear face to the surface does not become a problem, the copper film in the set-up cut width C is removable.

[0095]Next, the cleaning method by this washing station is explained. First, one is made to carry out horizontal rotation of the semiconductor substrate W to the substrate attaching part 922, where a substrate is horizontally held by the substrate attaching part 922 via the spin chuck 921. In this state, an acid solution is supplied to the center section by the side of the surface of the substrate W from the center nozzle 924. As this acid solution, what is necessary is just acid of a non-oxidizing quality, and fluoric acid, chloride, sulfuric acid, citrate, oxalic acid, etc. are used. On the other hand, an oxidizer solution is supplied to the edge part of the substrate W continuously or intermittently from the edge nozzle 926. Those combination is used, using sodium hypochlorite ozone water, hydrogen peroxide solution, nitric acid water, or water etc. as this oxidizer solution.

[0096]Thereby, in the field of edge cut width C of the edge part of the semiconductor substrate W, the copper film formed in the upper surface and the end face oxidizes quickly with an oxidizer solution, and dissolution removal is etched and carried out with the acid solution which is simultaneously supplied from the center nozzle 924 and spreads in the entire surface of a substrate. Thus, compared with supplying those mixed water from a nozzle beforehand, a steep etching profile can be obtained by mixing an acid solution and an oxidizer solution in a substrate edge part. A copper etching rate is determined by the concentration of them at this time.When the copper natural oxidation film is formed in the circuit formation part of the surface of a substrate, with the acid solution which spreads covering the entire surface of a substrate with rotation of a substrate, this natural oxidation thing is removed promptly and does not grow. After suspending supply of the acid solution from the center nozzle 924, by suspending supply of the oxidizer solution from the edge nozzle 926, the silicon exposed to the surface can be oxidized and adhesion of copper can be controlled.

[0097]On the other hand, an oxidizer solution and a silicon oxide etching agent are supplied to the rear-face center section of the substrate simultaneous or by turns from the back nozzle 928. It can oxidize with an oxidizer solution the whole silicon of a substrate, and the copper etc. which have adhered to the rear-face side of the semiconductor substrate W in metallic shapes by this can be etched and removed by a silicon oxide etching agent. It is desirable when the direction made into the same thing as the oxidizer solution supplied to the surface as this oxidizer solution lessens the kind of medicine. The kind of medicine can be lessened, if fluoric acid can be used and the acid solution by the side of the surface of a substrate also uses fluoric acid as a silicon oxide etching agent. By this, if oxidizer supply is suspended previously, a canal side will be acquired, if an etching agent solution is suspended previously, a saturation side (hydrophilic side) will be acquired, and it can also adjust to the rear face according to a demand of a subsequent process.

[0098]Thus, an acid solution, i.e., an etching reagent, is supplied to a substrate, after removing the metal ion which remains on the surface of the substrate W, pure water is supplied, pure water substitution is performed, an etching reagent is removed, and spin drying is performed after that. Thus, removal of the copper film in edge cut width C of the edge part of a semiconductor substrate surface and copper contamination removal on the back can be performed simultaneously, and, for example, this processing can be made to complete within 80 seconds. Although it is possible to set the edge cut width of edge as arbitration (2 mm - 5 mm), it does not depend on cut width for the time which etching takes.

[0099]Before the CMP process after plating, performing annealing treatment shows a good effect to next CMP treatment or the electrical property of wiring. When the surface of wide wiring (several micrometer unit) was observed without annealing after CMP treatment, many defects like a micro void were seen, and the electrical resistance of the whole wiring was made to

increase, but the increase in this electrical resistance has improved by performing annealing. When you have no annealing, to thin wiring, it is possible from a void not having been seen that the degree of grain growth is concerned. That is, in process of the grain growth accompanying [although grain growth does not happen easily in thin wiring] annealing treatment in connection with grain growth by wide wiring, The guess that the dent for micro voids arose in the wiring upper part by moving upwards can be performed detailed pore overly concentrating in like [SEM (scanning electron microscope) in a plating film is not visible, either]. As for addition (2% or less) and temperature, as for the atmosphere of gas, as an annealing condition of an annealing unit, the above-mentioned effect was acquired in 1 to 5 minutes at about 300-400 ** in hydrogen.

[0100]Drawing 22 and drawing 23 show the annealing unit 814. This annealing unit 814 is located in the inside of the chamber 1002 which has the gate 1000 take the semiconductor substrate W in and out of which, The hot plate 1004 which heats the semiconductor substrate W, for example at 400 **, and the cool plates 1006 which pour cooling water, for example and cool the semiconductor substrate W are arranged up and down. The inside of the cool plates 1006 is penetrated, it extends in a sliding direction, and two or more rise-and-fall pins 1008 which carry out installation maintenance of the semiconductor substrate W are arranged at the upper bed, enabling free rise and fall. The gas introducing pipe 1010 which introduces the gas for antioxidizing between the semiconductor substrate W and the hot plate 1008 at the time of annealing, It is introduced from this gas introducing pipe 1010, and is arranged at the position against which the gas exhaust pipes 1012 which exhaust the gas which flowed between the semiconductor substrate W and the hot plate 1004 stand face to face mutually on both sides of the hot plate 1004.

[0101]N_2 gas by which the gas introducing pipe 1010 flows into an inside through the inside of N_2 gas introducing path 1016 which has the filter 1014a, It is connected to the mixed gas introducing path 1022 through which the gas which mixed H_2 gas which flows into an inside through the inside of H_2 gas introducing path 1018 which has the filter 1014b with the mixer 1020, and was mixed with this mixer 1020 flows.

[0102]This holds the semiconductor substrate W carried in to the inside of the chamber 1002 through the gate 1000 by the rise-and-fall pin 1008, The distance of the semiconductor substrate W and the hot plate 1004 which held the rise-and-fall pin 1008 by this rise-and-fall pin 1008 makes it go up until it is set to about 0.1-1.0 mm, for example. In this state, via the hot plate 1004, the semiconductor substrate W is heated so that it may become 400 **, for example, the gas for antioxidizing is simultaneously introduced from the gas introducing pipe 1010, between the semiconductor substrate W and the hot plates 1004 is passed, and it exhausts from the gas exhaust pipes 1012. By this, the semiconductor substrate W is annealed preventing oxidation, this annealing is continued tens of seconds - about 60 seconds, for example, and annealing is ended. As for the cooking temperature of a substrate, 100-600 ** is chosen.

[0103]The distance of the semiconductor substrate W and the cool plates 1006 which held the rise-and-fall pin 1008 by this rise-and-fall pin 1008 makes it descend after the end of annealing until it is set to about 0-0.5 mm, for example. In this state, by introducing cooling water in the cool plates 1006, a semiconductor substrate is cooled about 10 to 60 seconds, for example, and the semiconductor substrate after this end of cooling is conveyed to a next process until the temperature of the semiconductor substrate W will be 100 ** or less. Although he is trying to pass the mixed gas which mixed N_2 gas and H_2 gas of several percent as gas for antioxidizing in this example, it may be made to pass only N_2 gas.

[0104]Drawing 20 is an outline lineblock diagram of electroless plating equipment. As shown in drawing 20, this electroless plating equipment, The holding mechanism 911 which holds the semiconductor substrate W which is a member to be plated on the upper surface, It has the

showerhead 941 which supplies plating liquid to the field of the semiconductor substrate W by which the seal was carried out in the edge part by the weir member 931 which carries out the seal of this edge part in contact with the edge part of the field (upper surface) of the semiconductor substrate W held at the holding mechanism 911 to be plated, and the weir member 931 to be plated. Electroless plating equipment is provided with the following.
The cleaning liquid supplying means 951 which is furthermore installed near the upper part periphery of the holding mechanism 911, and supplies a penetrant remover to the field of the semiconductor substrate W to be plated.
The recovery container 961 which collects the penetrant removers (plating waste fluid) etc. which were discharged.
The plating liquid recovery nozzle 965 which attracts and collects the plating liquid held on the semiconductor substrate W.
The motor M which rotates said holding mechanism 911.
Hereafter, each member is explained.
[0105]The holding mechanism 911 has formed the board mounting part 913 which lays and holds the semiconductor substrate W on the upper surface. This board mounting part 913 is constituted so that the semiconductor substrate W may be laid and it may fix, and it is installing the vacuum absorption mechanism which specifically carries out vacuum absorption of the semiconductor substrate W to that rear-face side and which is not illustrated. On the other hand, the back heater 915 which is surface state, heats the field of the semiconductor substrate W to be plated from the undersurface side, and keeps it warm is installed in the rear-face side of the board mounting part 913. This back heater 915 is constituted by the rubber heater, for example. It rotates by the motor M, and this holding mechanism 911 is constituted so that it can move up and down by the ascending and descending means which is not illustrated. The weir member 931 forms the seal part 933 which is cylindrical and carries out the seal of the periphery edge of the semiconductor substrate W to the lower part, and it is installed so that it may not move up and down from the position of a graphic display.
[0106]The showerhead 941 is providing many nozzles at a tip, and is a thing of the structure which distributes the supplied plating liquid in the shape of a shower, and is supplied to the field of the semiconductor substrate W to be plated at abbreviated homogeneity. The cleaning liquid supplying means 951 is a structure which spouts a penetrant remover from the nozzle 953. The plating liquid recovery nozzle 965 is constituted so that it can move up and down and circle, and it is constituted so that the tip may descend inside the weir member 931 of the upper surface edge part of the semiconductor substrate W and may attract the plating liquid on the semiconductor substrate W.
[0107]Next, operation of this electroless plating equipment is explained. The holding mechanism 911 is first descended rather than the state of a graphic display, the crevice between prescribed dimensions is established between the weir members 931, and the semiconductor substrate W is laid and fixed at the board mounting part 913. As the semiconductor substrate W, for example, phi 8-inch board is used. Next, go up the holding mechanism 911, the upper surface is made to contact the undersurface of the weir member 931 like a graphic display, and the seal of the periphery of the semiconductor substrate W is simultaneously carried out by the seal part 933 of the weir member 931. The surface of the semiconductor substrate W is in the state where it was opened wide, at this time.
[0108]Next, direct heating of the semiconductor substrate W itself shall be carried out with the back heater 915, the temperature of the semiconductor substrate W shall be 70 ** (it maintains till the end of plating), next the plating liquid heated by 50 **, for example is blown off from the showerhead 941, and plating liquid is poured on abbreviated [of the surface of the semiconductor substrate W / whole]. Since the surface of the semiconductor substrate W is surrounded by the weir member 931, all the poured-in plating liquid is held on the surface of the

semiconductor substrate W. A small quantity of the grade which serves as 1-mm thickness (about 30 ml) on the surface of the semiconductor substrate W may be sufficient as the quantity of the plating liquid to supply. The depth of the plating liquid held on a field to be plated is just 10 mm or less, and 1 mm of it may be sufficient like this example. If the plating liquid supplied like this example can be managed with a small quantity, the heating apparatus which heats this will also be small and will become good. And in this example, since the temperature of the semiconductor substrate W is heated at 70 ** and the temperature of plating liquid is heated at 50 **, the field of the semiconductor substrate W to be plated will be 60 **, and is made to the optimal temperature for the plating reaction in this example. Thus, since it is not necessary to carry out temperature up of the temperature of the required plating liquid of big power consumption to heating so highly if it constitutes so that the semiconductor substrate W itself may be heated, prevention of the reduction of power consumption and construction material change of plating liquid can be aimed at, and it is suitable. The power consumption for heating of the semiconductor substrate W itself may be small, and since there is little quantity of the plating liquid collected on the semiconductor substrate W, incubation of the semiconductor substrate W by the back heater 915 can be performed easily, the capacity of the back heater 915 may be small, and miniaturization of a device can be attained. If a means to cool the semiconductor substrate W itself directly is used, it is also possible to change heating and cooling during plating and to change plating conditions. Since the plating liquid currently held on the semiconductor substrate is little, temperature control can be performed with sufficient sensitivity.

[0109]And instant rotation of the semiconductor substrate W is carried out by the motor M, uniform ****** of a field to be plated is performed, and a field to be plated is plated with the state where the conductor substrate W was stood still the second half. Specifically rotate the semiconductor substrate W at 100 rpm or less only 1 sec, soak the field [to be plated] top of the semiconductor substrate W in plating liquid uniformly, it is made to stand it still after that, and the nonelectrolytic plating between 1min is made to perform. Even if instant turnover time is long, it is set to 10 or less sec.

[0110]After the above-mentioned plating processing is completed, the tip of the plating liquid recovery nozzle 965 is descended to the inner neighborhood of the weir member 931 of the surface edge part of the semiconductor substrate W, and plating liquid is sucked in. If the semiconductor substrate W is rotated with the revolving speed of 100 rpm or less at this time, the plating liquid which remained on the semiconductor substrate W can be brought together in the portion of the weir member 931 of the edge part of the semiconductor substrate W with a centrifugal force, and recovery of plating liquid can be efficiently performed in a high recovery rate. And drop the holding mechanism 911 and the semiconductor substrate W is separated from the weir member 931, A nonelectrolytic plating reaction is stopped by dilution and washing at the same time it starts rotation of the semiconductor substrate W, it injects a penetrant remover (ultrapure water) from the nozzle 953 of the cleaning liquid supplying means 951 to the field of the semiconductor substrate W to be plated and it cools a field to be plated. The weir member 931 may be simultaneously washed by applying the penetrant remover injected from the nozzle 953 at this time also to the weir member 931. The plating waste fluid at this time is collected and discarded by the recovery container 961.

[0111]The plating liquid used once is not reused but is considered as throwing away. Since quantity of the plating liquid used in this device as mentioned above is made very small compared with the former, there is little quantity of the plating liquid discarded even if it does not reuse. The plating liquid after use may also be collected to the recovery container 961 as plating waste fluid with a penetrant remover without installing the plating liquid recovery nozzle 965 depending on the case. And after carrying out the high velocity revolution of the semiconductor substrate W and carrying out spin drying by the motor M, it takes out from the holding mechanism 911.

[0112]Drawing 21 is an outline lineblock diagram of other electroless plating equipment. In

drawing 21, the point which is different from the aforementioned example is a point which installed the lamp heater (heating method) 917 above the holding mechanism 911, and unified this lamp heater 917 and showerhead 941-2 instead of forming the back heater 915 in the holding mechanism 911. That is, the lamp heater 917 of ring shape with which two or more radii differ, for example is installed in concentric circle shape, and the opening of many nozzles 943-2 of the showerhead 941-2 is carried out to ring shape from the crevice between the lamp heaters 917. As the lamp heater 917, it may constitute from one spiral lamp heater, and may constitute from a lamp heater of various, still more nearly other structure and arrangement.
[0113]Even if constituted in this way, plating liquid can be supplied uniformly [abbreviation with the shape of a shower] on the field of the semiconductor substrate W to be plated from each nozzle 943-2, and heating and incubation of the semiconductor substrate W can also carry it out to homogeneity directly with the lamp heater 917. In the case of the lamp heater 917, since the air of the circumference is also heated besides the semiconductor substrate W and plating liquid, there is also a heat insulation effect of the semiconductor substrate W.
[0114]In order to carry out direct heating of the semiconductor substrate W with the lamp heater 917, Since the lamp heater 917 of comparatively large power consumption is needed instead, the back heater 915 shown in the lamp heater 917 and said drawing 20 of comparatively small power consumption is used together, The semiconductor substrate W is heated mainly with the back heater 915, and incubation of the air of plating liquid and the circumference may mainly be made to perform it with the lamp heater 917. A means to cool the semiconductor substrate W directly or indirectly as well as the above-mentioned example may be formed, and temperature control may be performed.
[0115]
[Effect of the Invention]As explained above, even if the actual distance between electrodes (distance with the field used as an anode and a cathode to be plated) changes gradually with the dissolution of the anode by advance of plating according to this invention (it becomes large), Make the surface of the current plate located between a substrate and an anode act as the temporary anode (false anode), and the distance between electrodes (distance with the field used as a current plate and a cathode to be plated) on appearance always as it is fixed by nothing and this. Even if it uses a soluble thing as an anode, the homogeneity within a field of a plating film can be prevented from changing temporally.

[Translation done.]

CLAIMS

[Claim(s)]
[Claim 1]A plating device comprising:
A plating tub holding plating liquid.
A substrate holder which is arranged above said plating tub, places a field to be plated upside down, and holds a substrate enabling free attachment and detachment.
A plating liquid spray nozzle which injects plating liquid horizontally towards a center from a periphery of said plating tub.
A current plate which is arranged down the flat surface which said plating liquid spray nozzle makes in the upper part of a soluble anode which made plating liquid immerse in said plating tub, and has been arranged, and said anode, and rectifies a flow of plating liquid.

[Claim 2]The plating device according to claim 1 which said current plate is plate-like and is characterized by being arranged so that the whole surface of this anode may be covered to said anode and parallel.
[Claim 3]The plating device according to claim 1 or 2, wherein said current plate comprises porous membrane of polypropylene, polyethylene, or PTFE, a porous board, or a porous board of ceramics.
[Claim 4]The plating device according to any one of claims 1 to 3, wherein density of said current plate is set as a size in which plating liquid turns an inside of a current plate caudad, passes with prudence, and prevents the back run according to a flow of plating liquid introduced in a plating tub.
[Claim 5]The plating device according to claim 4, wherein density of said current plate is set as a size in which plating liquid of a flow of 1 - 5 L/min passes an inside of a current plate.

[Translation done.]